

W Z
100
9L527
1923

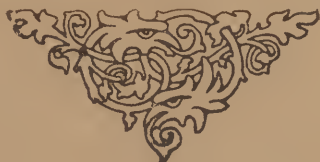
LIBRARY
WITHDRAWN

from

LIBRARY

NATIONAL INSTITUTES OF HEALTH

THE
JOSEPH LEIDY
Commemorative Meeting



HELD IN PHILADELPHIA, DECEMBER 6, 1923

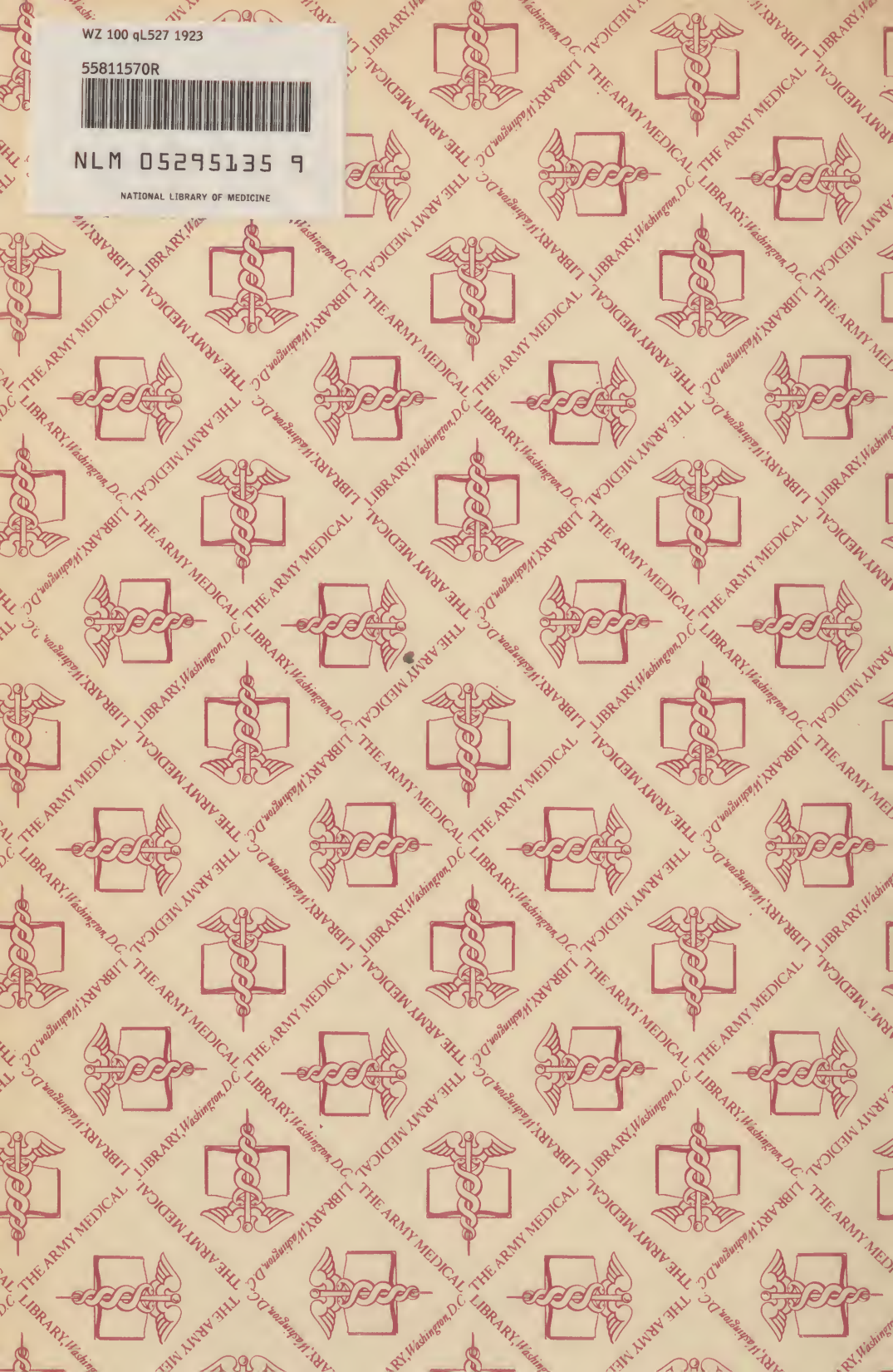
WZ 100 qL527 1923

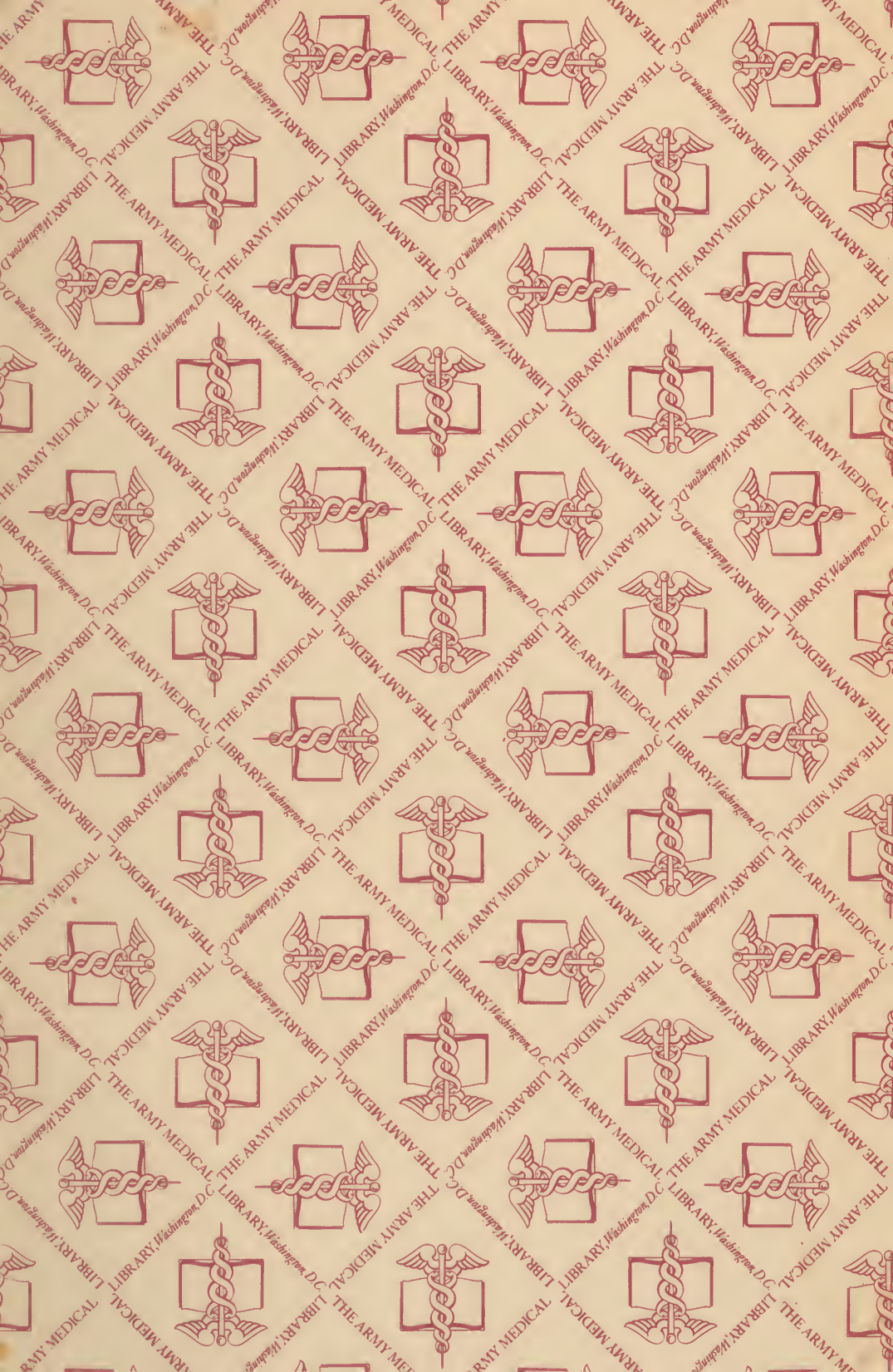
55811570R



NLM 05295135 9

NATIONAL LIBRARY OF MEDICINE







JOSEPH LEIDY
1823-1891.

THE
JOSEPH LEIDY
Commemorative Meeting

Held in Philadelphia, December 6, 1923

Under the Auspices of:

THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA

THE AMERICAN ASSOCIATION OF ANATOMISTS

THE AMERICAN ENTOMOLOGICAL SOCIETY

THE AMERICAN PHILOSOPHICAL SOCIETY

THE AMERICAN SOCIETY OF NATURALISTS

BOSTON SOCIETY OF NATURAL HISTORY

THE COLLEGE OF PHYSICIANS OF PHILADELPHIA

NATIONAL ACADEMY OF SCIENCES

SMITHSONIAN INSTITUTION

SWARTHMORE COLLEGE

UNIVERSITY OF PENNSYLVANIA

WAGNER FREE INSTITUTE OF SCIENCE

THE WISTAR INSTITUTE OF ANATOMY AND BIOLOGY

ZOOLOGICAL SOCIETY OF PHILADELPHIA.

WZ

100

L527

7 1923

c.1

CONTENTS.

	PAGE
Joseph Leidy, The Founder of American Parasitology. DR. HENRY B. WARD	3
Historical Sketch of the Joseph Leidy Commemorative Committee and Its Activities. JAMES A. G. REHN, Secretary of the Committee.....	9
Organizations Represented by Delegates.....	15
Organizations Sending Letters Appreciative of the Scientific Contributions of Joseph Leidy.....	18

THE PROGRAM OF THE SESSIONS

Opening Remarks. DR. R. A. F. PENROSE, JR.....	20
General Estimate of Leidy's Influence upon Scientific Thought and Develop- ment. DR. EDWARD S. MORSE.....	22
Zoological Work. DR. HERBERT S. JENNINGS.....	28
Palaeontological and Geological Work. DR. WILLIAM B. SCOTT.....	36
Joseph Leidy as a Botanist. DR. WITMER STONE.....	43
Mineralogical Work. DR. FRANK W. CLARKE.....	49
The Joseph Leidy Memorial Medal Foundation in the Natural Sciences..	52
Joseph Leidy, Founder of Vertebrate Palaeontology in America. PROF. HENRY FAIRFIELD OSBORN.....	54
Reminiscences of a Prosector and Appreciation of Leidy's Work as an Ana- tomist. DR. GEORGE E. DE SCHWEINITZ.....	61
Leidy and His Influence on Medical Science. DR. HOBART A. HARE.....	73

JOSEPH LEIDY, THE FOUNDER OF AMERICAN PARASITOLOGY.

BY DR. HENRY B. WARD, UNIVERSITY OF ILLINOIS

Most fields of biology are opened up gradually, at least to the extent that pioneer workers patiently accumulate data, usually in the form of disassociated and unrelated observations and isolated details, before the time is ripe for the master mind which builds of this inchoate material a new part of the great structure of science. The field of parasitology in America constitutes a striking exception to this general principle. Prior to 1846 no one in this country appears to have devoted any attention to the subject, and the few casual notes on parasites which have been dug out of earlier writings on other topics are too scanty and superficial to furnish foundation material for any study. Accordingly when in that year Dr. Leidy, scarce 23 years of age, began to devote his attention to studies on parasitic worms, he found himself confronted with the double task of gathering the material and of organizing it into scientific form. Moreover, while in some other fields in which he published, other investigators added interest and zest by their contributions, here he worked alone, and it was more than a quarter of a century before any other student in this country contributed in other than casual fashion to the subject of parasitology. Yet the work he undertook was performed so thoroughly that the descriptions and interpretations he published within the decade from 1846 to 1856 sufficed not only to lay the foundations of American parasitology, but also yielded him recognition as an authority in that field everywhere and contributed materially to the advancement of the subject in Europe where it had been studied intensively for more than half a century.

Joseph Leidy was born in Philadelphia on September 9, 1823. Nature had endowed him admirably for the part he was to play. Sprung from a lineage that represented the best in two great nations of the old world, he inherited artistic skill of no common order, love of nature and life, keenness of perception, accuracy of judgment and that foresight truly characteristic of a master mind, which enabled him to predict successfully the decisions of the future. These conditions will stand out more clearly after a

review of the general history of his family and the special training of the man.

Following close after the pilgrimage of William Penn into the Rhenish Palatinate, came to this country a wave of migrants from Germany that began about 1688 and contributed an important early element to the American stock. Among those who came were the first American ancestors of Joseph Leidy. In the old world the name was spelled variously, Leydig, Lydig, and Leidig, and was anglicized later by the English authorities in Pennsylvania into Leidy.

As early as 1338 one of this name, Johan Leydig, was living at Wilsnach in Swabia. Among his descendants was a chief burgher of Wilsnach, Joachim Leydig, whose son, the Rev. Matthew Leydig, studied theology with Luther at Wittenberg and was ordained by him in 1550. In 1552 he was called to the German Reformed Church at Halle where he died in 1601. He published a translation of the Bible (Berlin, 1586) and later the Lutheran vespers and psalms of David. Another of the family, Joachim Leydig, also a native of Halle, served as pastor of the Reformed Church at Königsberg in Prussia until in 1571 as the result of a doctrinal controversy he returned to Halle. Jacob Leydig, grandson of the Rev. Johan Leydig, and a scholar of note, published in 1677 a history of the ancient electors of Prussia. It was in this, the XVII Century, that armorial bearings were granted to the head of the house, Joachim Leydig, in recognition of his public services in founding a hospital. It is interesting to note that this same family has produced in recent years one other highly distinguished biologist, Professor Franz Leydig of Würzburg and Bonn whose great grandfather was a brother of Joseph Leidy's great grandfather.

Following the Thirty Years' War, the Palatinate was subjected to religious persecutions and as a direct result of these John Jacob Leydig emigrated from Wittenberg. He arrived in Philadelphia in 1729 and settled on a tract of 400 acres purchased from the Penns. This early settler, great grandfather of the naturalist, established a settlement known even to the present day as Leidytown, although the postoffice bearing this name is all that remains of the original town. His son, John Jacob Leidy, who fell heir to the homestead, found upon his land deposits valuable in the manufacture of pottery and utilized them so successfully that specimens of his workmanship of evident artistic merit are preserved in the exhibit of pottery of

Colonial times at Memorial Hall, Philadelphia. During the American Revolution he served as an officer in the Pennsylvania forces and played an active part in the events of the war in that region. His wife, Joseph Leidy's paternal grandmother, was Marie LeFebre, a sister of Francis Joseph LeFebre, a marshal of Napoleon I and a peer of France. To this joint French-German ancestry the grandson clearly owed many of the traits which enabled him to win such conspicuous success.

His son, Philip Leidy, inherited his father's land, and at the close of the Revolution settled in the city of Philadelphia where he engaged in industrial pursuits with marked financial success. During the war of 1812 he served as an officer. After Marshal LeFebre's death, being deeply involved in military affairs he named his sons Francis and Joseph, and hoped they would both seek fame in military careers. While the one son, Joseph, with whom this article is directly concerned, served with distinction in the Civil War, it was as surgeon in a military hospital and not in a position such as his father evidently had in mind.

Joseph Leidy's mother was Catherine Mellick (Moelich), who also was descended from natives of the Rhineland that had come originally to New Jersey and had later moved to Pennsylvania. She died when Joseph, who was her third child, was only twenty months old and he was reared by a stepmother, Christiana Mellick, of whose careful training Leidy often made grateful acknowledgment; "The only mother I have known" he said at one time, "she was all in all to me, the one to whom I owe all that I am."

During his early education the boy manifested little ability in the classical studies which were standard in that day but showed an eager interest in natural history even though it was not included in the curriculum. In his wanderings into the country in search of minerals, flowers and insects he absented himself at times from school and was indifferent to those sports which tempted most boys. His leisure seems to have been devoted to drawing objects of natural history and a note book still extant and dated 1833 shows that even at the age of ten he had cultivated, alone by himself, that accuracy in observation and fidelity in delineation which gave its high value to his later work. His father was so deeply impressed by this phase of his work that he resolved to make an artist of the boy. His mother, who was a woman of marked intelligence and foresight, had a firm conviction that her son should

receive a professional education, and as Leidy later stated, her strength "carried the point." His skill in making minute dissections already displayed on various occasions and his mother's confidence that she saw in him the traits which would make a great physician, led first to the study of anatomy under a private teacher and later to his matriculation at the University of Pennsylvania where he received the degree of doctor of medicine in 1844. But professional duties proved irksome and were entirely abandoned two years later in favor of scientific pursuits.

The story of Leidy's active life and his relations to the Philadelphia Academy of Natural Sciences, with which his name is inseparably connected and to whose upbuilding and reputation he made most noteworthy contributions in every department, has been so fully portrayed by contemporary biographers that the subject may be passed over here without further discussion.

It is clear that none of Leidy's biographers has recognized clearly the part he played in developing the field of parasitology, helminthology and medical zoology. In careful determination of minute structure he demonstrated himself in his first papers to be a master of accuracy and detail, and it was this characteristic which has made his work in parasitology so valuable and so permanent. In the first years of his career he confined his attention nearly exclusively to the study of the minute anatomy of lower invertebrates. Among the very first of his writings were two contributions to parasitology, one of them a significant observation on *Trichina*. Only a little later he was the first to demonstrate the animal nature of Gregarines and described in them certain minute fibrillae as muscular elements. These views were vigorously contested at the time but fully vindicated later. Between 1846 and 1858 he contributed about 60 articles on parasitology but thereafter for 10 years one finds hardly a line on the subject in his writings. Again in 1870 parasitology claimed his attention and in the last 15 years of his life, between 1876 and 1891, he contributed once more about 60 papers on various aspects of the subject. During these later years he worked with increasing intensity on parasitology, and although he completed a series of valuable papers, he left an immense mass of unfinished material. As is well known he had been planning the publication of a monograph in the field of parasitology, and to this unfortunately unrealized purpose had devoted practically his entire attention during these years.

His work on parasitology was conspicuously broad in its range. During the first period of research activity in that field he followed the lead of his European confreres with conspicuous success in describing new genera that in some cases though rejected at the time have since been generally accepted. While some of these suffered shipwreck on the rocks and shoals of nomenclatorial rules they were fundamentally sound and demonstrate fully the clarity of his conceptions of comparative anatomy. His mind was also keenly alive to the importance of biological data and his notes are full of significant observations on the habits of parasites and on their relations to man and to other animals. In his paper on *Nematoidea Imperfecta* he recorded, in 1851, one of the first attempts to determine experimentally the adult forms developing from these larval stages. Among the longer papers published in the latter part of his life are those dealing with tapeworms of birds, parasites of fish and of termites, and observations on leeches. He was one of the first to focus attention carefully on parasitic protozoa and made important contributions on parasitic amoebae, ciliates and sporozoa, especially of insect hosts. In endeavoring to compare his work on parasitology with that in other fields one notes, first of all, that in number of titles and in major publications it is second to his work on paleontology. It is true also that his monograph on *Fresh Water Rhizopods of North America* stands out as the most perfect of all of his contributions to knowledge, yet *A Flora and Fauna Within Living Animals* (1851) was epoch-making to a degree that places it in the forefront of all his publications.

Leidy's work in the field of parasitology was characterized to a remarkable extent by his keen scientific insight and power to anticipate correctly the probable results of future investigation. Among the many illustrations which might be instanced of his power it is possible to cite here only a few.

In October 1846 Leidy announced to the Philadelphia Academy that he had detected in the muscles of the hog a minute worm which he could not distinguish from *Trichina spiralis*, heretofore considered as peculiar to the human species. As one looks backward over the history of work on this parasite it is easy to see that the life history of *Trichina* might have been correctly interpreted many years earlier than was actually the case if the foreign investigators who knew of Leidy's work had given it adequate consideration. But they explained away his discovery, and it was 20

years before the scientific world came back to accept Leidy's conclusion that both hog and man served as hosts for the parasite, and found in this an explanation of the disease.

Many of Leidy's notes were very brief and his comments apparently casual, but they embodied fundamental conclusions that were novel at the time, even though they appear commonplace today. In 1853 he emphasized the importance of cooking as protection against diseases caused by animal parasites, for he had satisfied himself *by experiment* that entozoa are destroyed where brought to the temperature of boiling water. He commented often on the intimate relation of parasitic infection to diet. When he first saw *Hymenolepis diminuta* he pointed out why it had not been noticed before and predicted it would prove to be common. Later students have verified this and numerous other similar predictions.

As conspicuous instances of Leidy's power to grasp the significance of apparently trivial items one may well point also to his observations and comments on the rôle of flies in spreading disease, on the significance of the hookworm in the production of anemia, and on the meaning of his studies on spontaneous generation. In my opinion his most influential publication in the field of parasitology was *A Fauna and Flora Within Living Animals*. To estimate rightly its significance one must remember that the paper was written before science had given foundation for present day conceptions with reference to the origin of living things. Even before this he had demonstrated the presence in many diverse animals of an unsuspected series of living intestinal organisms which were here more fully described and their origin explained in detail. The doctrine of spontaneous generation was widely held and vigorously supported by scientific men of high rank. Perhaps the strongest support for the view was drawn from the field of parasitology, especially since the discovery of the complex development of parasitic organisms had so long eluded the efforts of investigators. In this paper Leidy challenged the advocates of spontaneous generation in unmistakable fashion. He maintained that no proof of a single instance had been furnished even among the simplest of living organisms but that on the contrary all investigations led farther and farther away from such a conception. His formulation of the arguments against the theory was pre-eminently that of a biologist and furnished arguments quite as powerful to many

minds as the later experiments of European investigators in other fields. This article was widely read and elicited everywhere outspoken praise which justified to the fullest extent Professor Henry's comment that it formed "the most remarkable paper on Physiology that has ever been produced by one of our countrymen."

Leidy's treatise on intestinal worms for Pepper's *System of Practical Medicine by American Authors* (1888) was the first comprehensive treatment of human parasites published on this continent. In the 32 years which had elapsed since the appearance of his *Synopsis of Entozoa and Some of Their Ecto-Congeners* he had pursued his studies on parasites almost alone. Indeed that synopsis which was in the fullest degree a pioneer work has remained even until within very recent years the only publication available on the parasitic fauna of North America. It was unique moreover among similar works in the wide range of material handled and in the fact that it was not a collation but represented the work of a single investigator.

In his studies on parasitology Leidy ventured upon an unopened field. He cultivated it alone for nearly half a century. He left finished work of permanent value and accumulated an immense amount of material that constitutes a mine of information for investigators today and will be of service in this field for many years to come.

HISTORICAL SKETCH OF THE JOSEPH LEIDY COMMEMORATIVE COMMITTEE AND ITS ACTIVITIES

At a meeting of the Council of the Academy of Natural Sciences of Philadelphia on January 2, 1923, the desirability of suitably commemorating the centenary of the birth of Joseph Leidy was voiced by members of that body. This was followed, at the meeting of the Academy held February 20, 1923, by the adoption of a resolution favoring such a commemoration and requesting the Council to consider the matter. On March 6, 1923, the Council authorized the President of the Academy to appoint a committee of three members of the Academy to consider the question of suitably commemorating the centenary of Dr. Leidy's birth. Dr. R. A. F. Penrose, Jr., President of the Academy, thereupon appointed James A. G. Rehn (Chairman), Dr. Joseph Leidy, 2nd., and George Vaux,

Jr. In accordance with power granted to it, this original Academy Joseph Leidy Commemorative Committee subsequently added Dr. Robert G. LeConte, Dr. Witmer Stone, and Dr. Francis X. Dercum to its members.

Several meetings of this Academy Committee were held and a plan was formed for a commemorative meeting in conjunction with a number of institutions and organizations in Philadelphia and elsewhere, as well as several of national character, with all of which Joseph Leidy had been associated. This plan was presented in a report to the Council of the Academy, April 3, 1923. Authorized to proceed by the Council and with the assurance of reasonable financial support by the same body, the Academy Committee extended invitations in the name of the Academy to thirteen institutions and organizations to participate in the proposed commemoration, and send one or more representatives to a meeting to be held May 2, 1923, in the Council Room of the Academy, to form a joint committee to perfect and carry out the tentative plan.

The selected organizations cordially responded to the Academy's invitation, and the participating members of the Joseph Leidy Commemorative Committee, as organized, were the following bodies: The Academy of Natural Sciences of Philadelphia, The American Association of Anatomists, The American Entomological Society, The American Philosophical Society, The American Society of Naturalists, Boston Society of Natural History, The College of Physicians of Philadelphia, National Academy of Sciences, Smithsonian Institution, Swarthmore College, University of Pennsylvania. Wagner Free Institute of Science, The Wistar Institute of Anatomy and Biology, and the Zoological Society of Philadelphia. The American Society of Naturalists and the National Academy of Sciences were not represented on the committee by representatives, although these organizations were participating members of the committee.

The representatives appointed by the participating organizations were as follows:

THE ACADEMY OF NATURAL SCI-
ENCES OF PHILADELPHIA

George Vaux, Jr.
Dr. Joseph Leidy, 2nd.
James A. G. Rehn
Dr. Robert G. LeConte
Dr. Francis X. Dercum
Dr. Witmer Stone

THE AMERICAN ASSOCIATION OF ANATOMISTS	Dr. H. H. Donaldson
THE AMERICAN ENTOMOLOGICAL SOCIETY	Dr. Henry Skinner R. C. Williams, Jr. E. T. Cresson, Jr.
THE AMERICAN PHILOSOPHICAL SOCIETY	Dr. E. G. Conklin Dr. C. E. McClung Dr. J. Percy Moore
BOSTON SOCIETY OF NATURAL HISTORY	Dr. Thomas Barbour
THE COLLEGE OF PHYSICIANS OF PHILADELPHIA	Dr. John B. Deaver Dr. George E. de Schweinitz Dr. W. J. Taylor
SMITHSONIAN INSTITUTION	Dr. George P. Merrill
SWARTHMORE COLLEGE	Dr. Samuel C. Palmer
UNIVERSITY OF PENNSYLVANIA	Dr. Robert G. LeConte Dr. C. E. McClung Dr. Allen J. Smith
WAGNER FREE INSTITUTE OF SCIENCE	Dr. Spencer Trotter Dr. Samuel C. Schmucker John G. Rothermel
THE WISTAR INSTITUTE OF ANATOMY AND BIOLOGY	Dr. M. J. Greenman
ZOOLOGICAL SOCIETY OF PHILADELPHIA	Dr. William L. Abbott Christian C. Febiger

With twenty members present this committee organized at the meeting of May 2, 1923, and elected the following officers: Dr. R. A. F. Penrose, Jr., President of The Academy of Natural Sciences of Philadelphia, as Honorary Chairman; Dr. Robert G. LeConte as Chairman; James A. G. Rehn, Recording Secretary of The Academy of Natural Sciences of Philadelphia, as Secretary. The appointment of an Executive Sub-Committee to select a suitable date and complete all arrangements for the meeting was authorized, and the Chairman appointed the following members: Dr. C. E. McClung, Dr. J. Percy Moore, George Vaux, Jr., Dr. Joseph Leidy, 2nd., Dr. William J. Taylor, Dr. H. H. Donaldson, and Dr. M. J. Greenman. The Executive Sub-Committee having power to add to its members, Dr. Francis X. Dercum was placed on the Sub-Committee, while Dr. Robert G. LeConte served as its

Chairman, and James A. G. Rehn as its Secretary, and later as Treasurer.

At this organization meeting of the Joseph Leidy Commemorative Committee it was announced that a "Joseph Leidy Memorial Medal" would be established as a trust with the Academy, to be awarded under terms not definitely determined at that time. The suggestion was made that the "Joseph Leidy Memorial Lecture in Science" under the University of Pennsylvania Foundation, which in 1923 would be given by Dr. Henry Fairfield Osborn, might be arranged for delivery on the same day the meeting was held, if a date acceptable to the speaker was selected. The question of the publication of a volume containing the addresses made at the meeting was discussed and referred to the Executive Sub-Committee.

Two subsequent meetings of the Joseph Leidy Commemorative Committee were held, one on November 26, 1923, the other on February 4, 1924. Reports were presented from the Executive Sub-Committee at each meeting, and at that of February 4, 1924, the Committee concluded its work and passed out of existence.

The work of the Joseph Leidy Commemorative Meeting was very largely done by the Executive Sub-Committee, which held meetings on May 7, May 18, June 9, June 29, October 22, November 12, November 26, December 19, 1923, and January 25, 1924. The date selected for the Commemorative Meeting was December 6, 1923. An engraved invitation, in the name of the fourteen participating organizations, was prepared and sent to three hundred and seventy-three learned institutions and societies throughout the world, requesting them to be represented by one or more delegates at the Commemorative Meeting. Acceptances of this invitation with the appointment of delegates were received from one hundred and thirty-six organizations, a list of which is printed on page 15. Thirty-two other institutions, which did not indicate delegates, communicated their deep interest in the Commemorative Meeting, and presented their felicitations to the participating organizations.

An attempt to do justice to the breadth of knowledge and multiplicity of activities of Joseph Leidy is not an easy matter, and the Sub-Committee's selection of the general topics for the addresses, as well as speakers fully able to analyze the work by Leidy in the subjects assigned to them, was equally difficult.

The work of the Executive Sub-Committee was facilitated by the

appointment of sub-committees of its own members who arranged the details of a number of the matters before it for consideration.

The financial support of the work of the Executive Sub-Committee, and thus of the Joseph Leidy Commemorative Committee, was made possible by the contributions of the following organizations: The Academy of Natural Sciences of Philadelphia, The American Philosophical Society, The College of Physicians of Philadelphia, Swarthmore College, University of Pennsylvania, The Wistar Institute of Anatomy and Biology, Zoological Society of Philadelphia, as well as by individual donations.

The publication of the present proceedings of the Commemorative Meeting has been made possible by individual contributions.

Invitations to be present at the sessions of the meetings were sent to about forty-three hundred individuals, very largely members of the participating organizations.

The program as finally arranged and presented was as follows:

12 Noon

Opening Remarks. By the Honorary Chairman, Dr. R. A. F. Penrose, Jr., President of the Academy of Natural Sciences of Philadelphia.

"General Estimate of Leidy's Influence upon Scientific Thought and Development." By Dr. Edward S. Morse, Peabody Museum of Salem, Salem, Massachusetts.

"Zoological Work." By Dr. Herbert S. Jennings, Johns Hopkins University.

1:30 P.M.

Luncheon — Exhibition of Leidyana.

2:30 P.M.

"Palaeontological and Geological Work." By Dr. William B. Scott, Princeton University.

"Botanical Work." By Dr. Witmer Stone, The Academy of Natural Sciences of Philadelphia.

"Mineralogical Work." By Dr. Frank W. Clarke, United States Geological Survey.

Announcement of the Leidy Medal Foundation in the Natural Sciences.

8:15 P.M.

The Joseph Leidy Lecture in Science (Under the University of Pennsylvania Foundation), "Joseph Leidy, Founder of Vertebrate Palaeontology in America." By Prof. Henry Fairfield Osborn, President of the American Museum of Natural History, New York City.

"Reminiscences of a Prosector and Appreciation of Leidy's Work as an Anatomist." By Dr. George E. de Schweinitz, University of Pennsylvania.

"Leidy and His Influence on Medical Science." By Dr. Hobart A. Hare, Jefferson Medical College.

The day sessions of the Commemorative Meeting were held in the Lecture Hall of The Academy of Natural Sciences of Philadelphia, while the evening session was held in Mitchell Hall of The College of Physicians of Philadelphia. By request of the Executive Sub-Committee, at its meeting of November 12, 1923, Dr. R. A. F. Penrose, Jr., President of the Academy, acted as Chairman of the sessions held at the Academy, while Dr. E. G. Conklin, Vice-President of the Academy, presided during the delivery of the addresses in the same hall. Dr. Josiah H. Penniman, Provost of the University of Pennsylvania, presided at the evening session at the College of Physicians. The luncheon was given in the Reading Room of the Academy and the attendance at one time during the day reached four hundred and fifty. The gathering, as a whole, was one of the most representative bodies of scientific men ever assembled in the halls of the historic Academy.

The exhibition of Leidyana was arranged by Dr. Joseph Leidy, 2nd., and Dr. Witmer Stone, and created great interest, containing as it did many personalia intimately associated with the life and work of Joseph Leidy. Chief among these might be mentioned the microscopes and lenses used by Dr. Leidy, many original drawings, note books and early journals, as well as the plaque of the Leidy Medal.

A series of volumes of the Academy's publications, as well as others, containing contributions of Joseph Leidy, were also exhibited.

The delegate register used at the Commemorative Meeting, and many of the more interesting letters received in response to the invitations to delegates, as well as certain of the individual letters

of acceptance, will be preserved in the archives of the Academy, along with copies of all the printed literature used in connection with the Joseph Leidy Centenary Meeting.

The "Joseph Leidy Memorial Medal," the foundation of which was announced at the meeting (see p. 52), was accepted as a trust by the Council of The Academy of Natural Sciences of Philadelphia at the meeting of December 4, 1923, and the deed of trust was read to the Academy at its meeting of December 18, 1923. It provides for the award of a bronze medal and an honorarium every third year, as "a reward for the best publication, exploration, discovery or research in the Natural Sciences in such particular branches thereof as may be designated, which award of said medal and honorarium once in three years and the conditions and limitations attending the same and all matters connected with the gift, shall be determined by a committee to be selected in an appropriate manner by the Academy."

The dies for the medal and the principal of the fund supporting the award were the gift of Dr. Joseph Leidy, 2nd.

ORGANIZATIONS REPRESENTED BY DELEGATES

ACADÉMIE ROYALE DES SCIENCES, DES LETTRES ET DES SCIENCES

MORALES ET POLITIQUES ET DES BEAUX-ARTS DE BELGIQUE.

ACADÉMIE DES SCIENCES, PARIS, FRANCE.

ACADEMY OF SCIENCES OF ST. LOUIS.

AMERICAN ACADEMY OF ARTS AND SCIENCES.

AMERICAN ACADEMY OF POLITICAL AND SOCIAL SCIENCE.

AMERICAN ASSOCIATION OF ANATOMISTS.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.

AMERICAN ASSOCIATION OF MUSEUMS.

AMERICAN CHEMICAL SOCIETY.

THE AMERICAN ENTOMOLOGICAL SOCIETY.

AMERICAN FERN SOCIETY.

AMERICAN GEOGRAPHICAL SOCIETY.

AMERICAN MUSEUM OF NATURAL HISTORY.

AMERICAN ORNITHOLOGISTS' UNION.

THE AMERICAN PHILOSOPHICAL SOCIETY.

THE AMERICAN PHYSIOLOGICAL SOCIETY.

AMERICAN PHYTOPATHOLOGICAL SOCIETY.

THE AMERICAN SOCIETY OF MAMMALOGISTS.

THE AMERICAN SOCIETY OF NATURALISTS.
THE AMERICAN SOCIETY OF ZOOLOGISTS.
AMHERST COLLEGE.
BOSTON SOCIETY OF NATURAL HISTORY.
BOTANICAL SOCIETY OF AMERICA.
BOTANICAL SOCIETY OF WASHINGTON.
BOYS' CENTRAL HIGH SCHOOL, PHILADELPHIA, PA.
BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.
CARNEGIE INSTITUTION OF WASHINGTON.
CARNEGIE MUSEUM.
CLARK UNIVERSITY.
THE COLLEGE OF PHYSICIANS OF PHILADELPHIA.
COLORADO SCIENTIFIC SOCIETY.
COLUMBIA UNIVERSITY, NEW YORK.
CONNECTICUT ACADEMY OF ARTS AND SCIENCES.
DARTMOUTH COLLEGE.
DELAWARE COUNTY INSTITUTE OF SCIENCE.
DELAWARE VALLEY ORNITHOLOGICAL CLUB.
DENISON UNIVERSITY.
DESERT BOTANICAL LABORATORY.
ECOLOGICAL SOCIETY OF AMERICA.
ENTOMOLOGICAL SOCIETY OF WASHINGTON.
EUGENICS RECORD OFFICE.
FRANKLIN INSTITUTE.
GEOGRAPHICAL SOCIETY OF PHILADELPHIA.
GEOLOGICAL SOCIETY OF AMERICA.
GEOLOGICAL SOCIETY OF LONDON.
HAHNEMANN MEDICAL COLLEGE, PHILADELPHIA, PA.
HARVARD UNIVERSITY.
HIRNANATOMISCHES INSTITUT, ZÜRICH, SWITZERLAND.
HISTORICAL SOCIETY OF PENNSYLVANIA.
INSTITUT OcéANOGRAPHIQUE, MONACO.
IOWA ACADEMY OF SCIENCE.
JEFFERSON MEDICAL COLLEGE OF PHILADELPHIA.
THE JOHNS HOPKINS UNIVERSITY.
LAFAYETTE COLLEGE.
LEHIGH UNIVERSITY.
LELAND STANFORD UNIVERSITY.
LINNEAN SOCIETY OF LONDON.
LINNEAN SOCIETY OF NEW YORK.

MARINE BIOLOGICAL LABORATORY, WOODS HOLE, MASS.
MINERALOGICAL SOCIETY OF AMERICA.
MINNESOTA HISTORICAL SOCIETY.
MISSOURI BOTANICAL GARDEN.
NATIONAL ACADEMY OF SCIENCES.
NATIONAL MUSEUM OF VICTORIA.
NATIONAL RESEARCH COUNCIL, WASHINGTON, D. C.
NATIONAL SOCIETY OF THE SIGMA XI.
NEW HAMPSHIRE ACADEMY OF SCIENCE.
NEW YORK ACADEMY OF SCIENCES.
NEW YORK BOTANICAL GARDEN.
NEW YORK ENTOMOLOGICAL SOCIETY.
NEW YORK STATE MUSEUM.
NEW YORK ZOOLOGICAL SOCIETY.
OBERLIN COLLEGE.
OHIO STATE ACADEMY OF SCIENCE.
OHIO STATE UNIVERSITY.
THE PALAEONTOLOGICAL SOCIETY OF AMERICA.
PEABODY MUSEUM OF SALEM.
PENNSYLVANIA CHAPTER OF THE SOCIETY OF THE SIGMA XI.
PENNSYLVANIA STATE COLLEGE.
PHILADELPHIA COLLEGE OF PHARMACY AND SCIENCE.
PHILADELPHIA COUNTY MEDICAL SOCIETY.
RICE INSTITUTE.
ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH.
ROYAL SOCIETY OF EDINBURGH.
RUTGERS COLLEGE.
SENCKENBERGISCHE NATURFORSCHENDE GESELLSCHAFT.
SMITH COLLEGE.
SMITHSONIAN INSTITUTION.
SOCIEDAD CIENTIFICA "ANTONIO ALZATE."
SOCIEDAD CIENTIFICA ARGENTINA.
SOCIÉTÉ BELGE DE GÉOLOGIE, DE PALÉONTOLOGIE ET D'HYDRO-
LOGIE.
SOCIÉTÉ GÉOLOGIQUE DE FRANCE.
SOCIÉTÉ ROYALE ZOOLOGIQUE ET MALACOLOGIQUE DE BELGIQUE.
SOCIÉTÉ ZOOLOGIQUE DE FRANCE.
SOCIETY OF ECONOMIC GEOLOGISTS.
STATE UNIVERSITY OF IOWA.
SULLIVANT MOSS SOCIETY.

SURGEON GENERAL'S OFFICE, UNITED STATES WAR DEPARTMENT.
SWARTHMORE COLLEGE.
TORREY BOTANICAL CLUB.
TUFTS COLLEGE.
UNION OF AMERICAN BIOLOGICAL SOCIETIES.
UNITED STATES BUREAU OF ANIMAL INDUSTRY.
UNITED STATES BUREAU OF ENTOMOLOGY.
UNITED STATES BUREAU OF PLANT INDUSTRY.
UNITED STATES DEPARTMENT OF AGRICULTURE.
UNITED STATES GEOLOGICAL SURVEY.
UNITED STATES PUBLIC HEALTH SERVICE.
UNIVERSITY OF CHICAGO.
UNIVERSITY OF MICHIGAN.
UNIVERSITY OF MINNESOTA.
UNIVERSITY OF MISSOURI.
UNIVERSITY OF NEW MEXICO.
UNIVERSITY OF PENNSYLVANIA.
UNIVERSITY OF PITTSBURGH.
UNIVERSITY OF WASHINGTON.
UTAH ACADEMY OF SCIENCE.
VASSAR COLLEGE.
WASHINGTON ACADEMY OF SCIENCE.
WILSON ORNITHOLOGICAL CLUB.
THE WISTAR INSTITUTE OF ANATOMY AND BIOLOGY.
YALE UNIVERSITY.
ZOOLOGICAL MUSEUM OF THE UNIVERSITY OF MINNESOTA.
ZOOLOGICAL SOCIETY OF LONDON.
ZOOLOGICAL SOCIETY OF PHILADELPHIA.

ORGANIZATIONS SENDING LETTERS APPRECIATIVE
OF THE SCIENTIFIC CONTRIBUTIONS OF
JOSEPH LEIDY.

ACADÉMIE DES SCIENCES, BELLES-LETTRES ET ARTS DE LYON,
LYON, FRANCE.
AMERICAN ANTHROPOLOGICAL ASSOCIATION.
BAYERISCHE AKADEMIE DER WISSENSCHAFTEN, MUNICH, GERMANY.
BERNICE PAUHI BISHOP MUSEUM OF POLYNESIAN ETHNOLOGY
AND NATURAL HISTORY, HONOLULU, H. I.
BRITISH MUSEUM OF NATURAL HISTORY, LONDON, ENGLAND.

- BUFFALO SOCIETY OF NATURAL SCIENCES, BUFFALO, N. Y.
BUREAU OF SCIENCE OF THE PHILIPPINE ISLANDS, MANILA, P. I.
DEPARTMENT OF MINES, HALIFAX, NOVA SCOTIA, CANADA.
GEOLOGICAL SURVEY OF INDIA, CALCUTTA, INDIA.
ILLINOIS STATE MUSEUM OF NATURAL HISTORY, SPRINGFIELD, ILL.
INSTITUTE OF JAMAICA, KINGSTON, JAMAICA.
KONINKLIJKE AKADEMIE VAN WETENSCHAPPEN, AMSTERDAM,
HOLLAND.
KRÁLOVSKÁ ČESKÁ SPOLEČNOST NAUK, PRAGUE, CZECHOSLOVAKIA.
LINNEAN SOCIETY OF NEW SOUTH WALES, SYDNEY, NEW SOUTH
WALES, AUSTRALIA.
MUSEO DE LA PLATA, LA PLATA, ARGENTINA.
MUSEU GOELDI DE HISTORIA NATURAL E ETHNOGRAPHIA, PARÁ,
BRAZIL.
MUSÉUM D'HISTOIRE NATURELLE, PARIS, FRANCE.
MUSEUM TEYLER VAN DER HULST, HAARLEM, HOLLAND.
NATURFORSCHENDE GESELLSCHAFT, BASEL, SWITZERLAND.
NATURFORSCHENDE GESELLSCHAFT IN FREIBURG, FREIBURG,
GERMANY.
NATURHISTORISCHES MUSEUM, VIENNA, AUSTRIA.
NATURWISSENSCHAFTLICHER VEREIN IN HAMBURG, HAMBURG,
GERMANY.
PREUSSISCHE AKADEMIE DER WISSENSCHAFTEN, BERLIN, GERMANY.
QUEENSLAND MUSEUM, BRISBANE, QUEENSLAND, AUSTRALIA.
SOCIÉTÉ DE BIOLOGIE, PARIS, FRANCE.
SOUTH DAKOTA SCHOOL OF MINES, RAPID CITY, SOUTH DAKOTA.
UNIVERSITÄTSINSTITUT FÜR KREBSFORSCHUNG AN DER CHARITÉ,
BERLIN, GERMANY.
WELCOME RESEARCH LABORATORIES, KHARTOUM, SUDAN, AFRICA.
WISCONSIN ACADEMY OF SCIENCES, ARTS AND LETTERS, MADISON,
WISCONSIN.
ZOOLOGICAL SOCIETY OF LONDON, LONDON, ENGLAND.
ZOOLOGICAL SURVEY AND MUSEUM OF MINNESOTA, MINNEAPOLIS,
MINN.
ZOOLOGISCHE GESELLSCHAFT ZU HAMBURG, HAMBURG, GERMANY.

MORNING SESSION

(At the Academy of Natural Sciences of Philadelphia)

DR. R. A. F. PENROSE, JR.,

President of The Academy of Natural Sciences of Philadelphia.

Opening Remarks.

It is a great pleasure to extend to you on the part of the Academy of Natural Sciences of Philadelphia a most cordial welcome to its halls at this commemoration of the hundredth anniversary of the birth of our illustrious former member, Doctor Joseph Leidy. Almost a third of a century—a generation in human history—has passed since his death; but the spirit of the man and his work still exercises an influence in science which grows stronger and stronger as time passes.

We are glad that he did much of his work here and we cherish his memory as one of our most precious traditions, but we realize that he did not belong to us alone but to the world, that all the societies and other organizations represented at this meeting, and many others, have a right to claim him as a guiding genius, for he was a member of many of them and an inspiration to all of them.

In fact scientific workers throughout the world can properly do honor to his memory for his work has carried its influence to the furthestmost lands to which scientific research has reached. It is therefore a fitting tribute to the memory of Doctor Leidy that this commemorative meeting is so generously and so amply recognized in such a splendid representation from many institutions of learning.

You have a number of interesting addresses to hear today and I will not take more of your time than to say that the Academy extends to you a most hearty greeting and expresses its deep appreciation of the assemblage that has done it the honor to gather here on this occasion.

SECRETARY—MR. REHN:

I have been requested to announce that in order not to intrude on the time of those who are to make addresses, by giving the names of delegates, there has been printed a list of the delegates and the societies they represent, and it is now in the hands of those present, so it will not be necessary to read it. Supplementary to this list, which went to press some few days ago, the committee has been notified of the appointment of the following delegates from a

number of additional societies, and in some cases additional representatives.

(Reads names of additional delegates)

DR. PENROSE:

We are fortunate in having with us one of Dr. Leidy's most distinguished followers, and he has kindly consented to preside during the reading of the addresses to-day. It is a pleasure to introduce Dr. Conklin, Vice-President of the Academy of Natural Sciences, and Professor of Biology in Princeton University.

CHAIRMAN—DR. CONKLIN:

We have met to honor the memory and to perpetuate the influence of the greatest naturalist that America has produced. There have been other great naturalists produced in this country. Cope was one of them, Dana was another. There came to this country Louis Agassiz whose influence was enormous, but I think that it may be truly said that considering the breadth of his work and the thoroughness and accuracy and influence of that work, Joseph Leidy leads them all as the greatest naturalist that America has produced.

We cannot do anything for Joseph Leidy. We can honor his memory, but we cannot do anything for him, but he can still do much for us, and that, I think, should be the keynote of this meeting, namely, to get from the life and work of Leidy, which we here commemorate, inspiration and influence for further work in those sciences which he loved so much, and to which he devoted his entire energy and his whole life.

I am not here to speak of Leidy. Others are to do that, and as I understand it, it is my duty to introduce those who are to speak to you.

The President of the Academy said, just now, that I was a follower of Leidy. I am a follower, rather afar off, I fear, but nevertheless a follower. It was my privilege to have come to Philadelphia (alas! after the death of Leidy), to have sat in the seats of the mighty, to have taught in his classrooms, to have used his library and his collections, and to have gotten some of the inspiration that came from the life of this great man, but after all, I did not know him as many here did. I did not know him as a friend as those who were associated with the Academy

and the University of Pennsylvania knew him. They will tell you more of him than I could possibly say, and so I shall close my remarks at this point and proceed to introduce to you the speakers who are to address you on this occasion.

It is a great privilege and honor that we are to have as the first speaker in this centenary celebration one who knew Leidy intimately,—one who was associated with him, one who in a measure belonged to his generation, and who knew him as probably few of us did. I shall not attempt to introduce to you Dr. Edward S. Morse, of the Peabody Museum of Salem, Salem, Massachusetts, for you all know him. May I, Dr. Morse, present the delegates in this audience to you. [The audience rose to greet Professor Morse.]

DR. EDWARD S. MORSE,

PEABODY MUSEUM OF SALEM.

General Estimates of Leidy's Influence upon Scientific Thought.

It was with some hesitation that I accepted the invitation of your committee to prepare an address on the subject of Joseph Leidy's influence on the science of his time. It is true that I am probably one of the oldest members of your Academy, but it seems to me that a member nearer home and consequently more intimate with Leidy's life and work would have been better chosen.

When Joseph Leidy began his studies there were only two centers of scientific study in this country, and these two centers were Philadelphia and Boston. In these two centers were established organizations that in a way paralleled each other. Philadelphia had its Academy of Natural Sciences, and Boston its Society of Natural History; Philadelphia had its American Philosophical Society, and Boston had its American Academy of Arts and Sciences. The American Academy was organized in 1780, thirty-seven years after the Philosophical Society, and both had among their members the immortal Philadelphian and Bostonian, Benjamin Franklin, who was the founder of the American Philosophical Society.

Of the transactions of these societies, the memoirs and communications were of a similar nature. There were, it is true, isolated students of science in other parts of the country, but definite societies and museums there were few or none. In scientific work, Philadelphia antedated Boston by nearly a century. The labors of those men, John and William Bartram, easily marked

Philadelphia as the pioneer city in scientific work. Linnaeus corresponded with John Bartram, and pronounced him the greatest modern botanist in the world. John Bartram is described by his son William, as a man of modest and gentle manners, frank, quiet, and of great good nature. It would seem from this characterization that the mantle of John Bartram had descended on Joseph Leidy. It was in the territory about Philadelphia that the Bartrams had roamed and studied, and it was over this same region that Leidy found the material for his work in its woods, fields, and ditches.

Leidy was a naturalist in the broadest sense, and his scientific contributions to the number of hundreds embraced the wide field of comparative anatomy, zoology, botany, paleontology, and mineralogy. In the last century throughout the entire range of the animal and plant kingdom, the country was rich in undescribed species. To the young naturalist the fascination of discovering and describing new species was overwhelming, and some there are who have never outgrown this lust. What wonder that the zoologists and botanists of that era devoted their energies to the work of detecting and defining new forms. Agassiz used to say that the species described typified the mason who supplied the bricks for the edifice, an important work to be accomplished, but followed by the same disaster if done improperly. With the growing scarcity of undescribed species the same kind of mental energy is nowadays concentrated on defining new genera, and this tendency is becoming so accentuated that one may predict with certainty that ultimately every species will have its own generic name, and in print accompanied by an appalling synonymy. As the curious rules of nomenclature permit of more than one specific name we shall soon have—but enough of this.

Joseph Leidy, in the midst of this greed and rush for new species, steadily pursued his researches on the habits and anatomical details of creatures embracing the entire animal kingdom from the lowest rhizopod to the highest mammal. He described the new species and genera as they naturally revealed themselves in the course of his investigations, but this work was subsidiary to his greater studies. One stands amazed at the wide range of his observations. The diversity of his work began when he was comparatively a young man. Others will address you on this subject, but I cannot refrain from calling your attention to the indices of the PROCEEDINGS of this Academy for the years of 1846, 1847, and

1848, to illustrate the breadth of his studies. He it was who determined that America was the ancestral home of the horse. His profound knowledge of the osteology of mammals enabled him to identify a fragment of a fossil tooth as belonging to a species of rhinoceros. Naturalists and paleontologists were sceptical as to the rhinoceros ever having lived in America, yet, later, in the same region in Nebraska, by a remarkable coincidence, the fossil skull of an unmistakable rhinoceros was exhumed, and the remains of the very tooth was found embedded in its jaw.

That eminent zoologist, William K. Brooks, in a memoir on Leidy says, "He laid with the hands of a master the foundation for the paleontology of the reptiles and mammals of North America, and we know what a wonderful and instructive and world-renowned structure his successors have reared upon his foundation." Leidy's first communication to the Academy on paleontology was in the year of 1847, and his last communication on the subject was in the year of 1888. Nearly a third of his memoirs to the number of 216 were devoted to this subject alone, absorbing nearly forty years of his life. This task would have given him the world wide reputation he sustained as a great naturalist, but at intervals during this prodigious work he found time to make investigations in many other and widely varied subjects in the animal and plant kingdoms, accompanied by innumerable drawings of the utmost delicacy and refinement. At a recent celebration, in Philadelphia of the centenary of Louis Pasteur, Dr. Hobart A. Hare, in a felicitous speech at the dinner given on that occasion, pointed out a number of striking parallelisms in the lives of Leidy and Pasteur. It was indeed a high honor to sustain resemblances to this immortal genius, and one who knows the history of these great men realizes the justice and accuracy of these comparisons.

Leidy's memoir entitled *A Flora and Fauna within Living Animals*, accepted in 1851 by the Smithsonian Institution and published in its "Contributions to Knowledge," contains a long introductory chapter, in which are discussed questions of the origin of life, spontaneous generation, years in advance of Pasteur and Darwin and anticipating many of their conclusions.

In an address given by Dr. Henry C. Chapman, at the unveiling of the statue of Leidy, in Philadelphia, in 1907, he quotes from a memoir by Leidy, in 1853, written six years before the appearance of Darwin's great work on the origin of species, and says, "where,

it may be asked, can there be found in the whole range of biological literature a more concise record of the origin of life, the extinction of species, the survival of the fittest, in a word, of Darwinism?"

I remember attending a stated meeting of this academy over fifty years ago. Leidy and other naturalists were present and the charming atmosphere and genial discussions reminded me of similar meetings of the Boston Society of Natural History at the same period: an identical group of kindly men, the amiable discussions without a tinge of acrimony, remains a lasting impression. The days of Gilbert White have long since vanished; have we also lost the stage typified by Leidy, Conrad, Lea, Haldeman, Meehan, Morton, and others of like character? To a young collector of natural history objects it must have been an inspiration to attend these meetings, and to realize that scholarly men were soberly discussing the habits of a common worm, or the structure of a beetle's leg. To see spectacled gentlemen seriously admiring little shells in a pasteboard tray, to appreciate how a well-written label added dignity to a trifle; to further realize that the little collection of natural history objects which they had brought together and for the collecting of which they had been laughed at or sneered at by unsympathetic neighbors were regarded by those men with interest and respect. Alas! these blissful days have passed. I know by my own experiences that the collectors' interests have vastly changed since those days. In the middle of the last century private collections of shells and other objects of natural history were not uncommon. The spirit of collection still survives but other classes of objects claim its attention—postage stamps, coins, book plates, etc., are deemed worthy of accumulation. The same tendencies are recognized in England. An eminent English authority in a report to the Liverpool Free Museum laments that "private collections are failing in Liverpool and all around, and teaching is hard and hardening in its results."

Leidy's profound range of knowledge, coupled with his willingness to answer inquiries, made him eagerly sought for; and crystals, precious stones, flowers, fossil forms and all kinds of animals were submitted to him for identification. It was the personal contact of a great master with students of every branch of natural history in which Leidy's influence on the science of his time exerted its greatest effect; questions answered, difficult attributions explained, obscure points made clear, all with a generosity of time, a kindliness

of heart that left grateful and lasting impressions on the student. As a young man I marveled at the delicacy of his drawings, particularly his drawings made under the microscope, especially those depicting the anatomy of the terrestrial mollusks of the United States. He used a peculiar enameled paper, of which he gave me a number of sheets, and a metallic pencil. His gentle and cordial manner won my heart at once, and I went back home greatly encouraged in my studies by this simple interview. His broad and unprejudiced attitude was well shown in an incident which occurred at the meeting of the American Association for the Advancement of Science, at Troy, N. Y., in 1871. At this meeting I gave my views as to the systematic position of the brachiopods, endeavoring to show that these animals had no relation to the branch of mollusca with which they had always been associated, but that their affinities were with the class of worms. Leidy was at this meeting but not a word in protest was expressed by him in contradicting these views; not that he agreed with me for he did not, but, as I believe, from mere kindness of heart he refrained from combating my heresies publicly. After the meeting, however, he came to me and quietly protested my views. I remember very clearly he urged me to save what little reputation I might have acquired as a student of mollusca by warning me to be sure of my ground before publishing. I confessed to him that perhaps I had not made myself clear in my extemporary remarks on the subject, but when he had seen my memoir with its illustrations and arguments it might possibly modify his views. Some months after in acknowledgment of my pamphlet, I got the following note from Leidy: "I have just finished reading the little book you so kindly sent me on the 'Systematic Position of the Brachiopoda'. These, I think, you have clearly proved not to be true mollusks and to be more nearly related to the worms. It is singular how long mere outward resemblances deceive us and how reluctant we become to be undeceived."

Dr. Amos Binney, of Boston, published a work in three volumes, *The Terrestrial Air-Breathing Mollusks of the United States*. All the species then known were illustrated by steel engravings done by a Philadelphia artist. It was for this work that Dr. Leidy made a study of the anatomical structure of many species and the drawings illustrating these details for delicacy and beauty have never been equalled. Ten years before this work appeared, Dr. S. S.

Haldeman, a member of this Academy, published a monograph, *The Air-Breathing Fresh Water Mollusks of the United States*, illustrated with colored steel engravings, so perfect, that for accuracy and beauty they have never been surpassed. Of the 86 species figured half of them had been discovered and named by Thomas Say, a Philadelphian. Dr. Binney regarded Thomas Say as the earliest scientific naturalist that this country had produced. Dr. Binney was a Bostonian with all the proverbial pride of that city. He dedicated his great work in the following words. "To the Academy of Natural Sciences of Philadelphia, to whose founders is due the first effective impulse given to the study of natural science of North America, and whose labors have been mainly instrumental in developing the natural history of this country."

It is interesting to note that Dr. Binney's son, William G. Binney, inherited the tastes of his father, and continued his father's investigations with the greatest success; it is further interesting to observe that young Binney gravitated to Germantown, near Philadelphia, where he pursued his studies to the end of his life. Here he found as his associates, Lea, Conrad, Haldeman, Tryon, and other distinguished students of mollusca, all members of this Academy.

Superadded to all these advantages he had access to the Academy's collection of shells—one of the greatest in the world, and now in charge of Dr. Henry A. Pilsbry, one of our most distinguished malacologists.

In the preparation of this brief address it has been difficult to refrain from trenching on the grounds of others who honor us with their presence, in truth the ground is broad enough for all, but it was necessary to understand the transcendent merits of this humane and world-famed naturalist in order to realize the profound influence he must have exerted on his colleagues in this center of scientific culture. A standard was set by Leidy in every department of natural science, and however feebly this standard may have been attained by some, insensible pressure must have been continually exerted by the work of this great man in their midst. Philadelphia undoubtedly owes today its supremacy in natural science and the exalted character of its scientific institutions to the work and example of this distinguished scholar.

CHAIRMAN—DR. CONKLIN:

We live at present in an age of great specialization. Dr. Leidy was one who represented all the natural sciences. The naturalists of the old school dealt not merely with zoology, but also botany, anatomy, geology, paleontology, even mineralogy, and yet in spite of the fact that we are no longer able to do this, I think that it might be said that we are making progress in the only direction in which biological progress is possible, namely increasing specialization. Increasing specialization is the mark of biological progress only if it is associated with increasing coöperation; but coöperation has not kept pace with specialization. I attended a meeting of the American Society of Naturalists in this city in 1895, and I recall very well the discussion in the symposium of the naturalists on that occasion,—a discussion that was participated in by Cope and other naturalists of the old school. I think of the discussions which we have at the present time and of the narrowing of our societies and of our journals, of the increasing number of journals devoted to specific fields, and finally of a project now on foot to split up the journals into constituent articles so that specialization may be carried still further. All of this may be in the direction of progress, as I say, if only we don't forget that other very important feature of progress, namely, coöperation.

We have had this delightful address from Dr. Morse, who represents in the very best sense of the word the old school of naturalists, and now we are to hear from a naturalist of the new school, one who represents rather the intensive than the extensive type of knowledge—one who is not merely a naturalist, as many people have understood that word, but who is our leading zoological and biological philosopher.

I have great pleasure in introducing to this audience Professor Jennings, of the Johns Hopkins University, who will speak upon the zoological work of Dr. Leidy.

DR. HERBERT S. JENNINGS,
JOHNS HOPKINS UNIVERSITY.

Leidy's Zoological Work.

So many-sided was Leidy's work, even in the single field of zoology, that whoever examines it must be skeptical of the adequacy of his own impressions. And particularly will he be skeptical as to the adequacy of any brief unified presentation, such as it falls to

my lot to attempt. The most I can hope is to illuminate a few of the many facets which his work presents.

Leidy seems to have attempted, and carried out to a remarkable degree of success, the bold project of forming for himself and communicating partly to others, a detailed picture of the entire living world in its natural relations to the environment. His zoological work is part of that effort. We find from him contributions on almost every one of the main groups of animals; and touching most aspects of their biology. The subjects of his published communications range from man and the other vertebrates down through the insects, arachnids, crustacea, annelids, rotifera, flatworms, nematodes, tapeworms, bryozoa, mollusca, echinoderms, coelenterates, and sponges, to the lowest of the protozoa; and they deal with the structure, habits, reproduction, distribution, and general biological relations of these creatures.

In his youth, we are told, Leidy's aptitudes were such that his father designed him for the career of an artist (though this design was overruled by the family court of last resort). In this fact lies, I believe, the key to an understanding of many features of his work in science. His work is largely a *portrayal* of nature as seen by a thorough scientific artist. It is artistic in spirit, not merely superficially, in the beautiful figures with which he illustrated it, but in its essential nature. His manifold contributions, of which between 500 and 600 are listed, may be compared to the studies from nature by a painter, ranging from the quick sketches in a few strokes, represented by his hundreds of brief communications to the Proceedings of the Academy of Natural Sciences of Philadelphia, through pictures of all grades of working out up to such great and finished masterpieces as the volume on the fresh water rhizopods. All are mainly pictures of nature, not analytical treatises. To him biology was not, as it now is to so many, so much a series of problems to be solved as it was a continent to be explored, a landscape to be portrayed. There is little of experimental or statistical or conceptual analysis in his work, it contains few hypotheses or generalizations. Where such are mentioned, they are not as a rule looked upon as part of the material for investigation; not as matters to be tested by analysis of his data; he rarely draws from his observations conclusions concerning them. His work is a portrayal of nature as he saw it, and no one else in America has made for himself, so uniformly worked-out, a picture of the world of organisms.

Now, of course, this means a scientific picture, with all that that implies of minute study of details, and of portrayal of these details in correct relations; his work was as far as possible from impressionistic. And the comparison with the work of the artist must of course not be pressed too far. Leidy had, too, the instincts and the capabilities of the analyst, the experimenter, the generalizer. In some of his earliest work, as we shall see, the products of those instincts are conspicuous; but in his later zoological work they are largely absent; and for a brief characterization, that as the scientific artist of nature is, on the whole, one that helps.

For his completer pictures in zoology he chose those groups of organisms which came naturally to hand. Living in Philadelphia, these were chiefly the inhabitants of the fresh-water ponds and streams. Contributions there are, and important ones, on the invertebrates of the land, of the air, and of the seashore; on parasitic organisms and on marine animals; but of life in the fresh waters his pictures are most numerous and detailed.

Outside of that field, however, lie his first really worked out pictures, the paper on the parasites of the termites, and that on *A Flora and Fauna within Living Animals*, published in 1853. It is not my province to speak of his work in parasitology, save in its relations to general zoology, but these papers are of great general interest. Both are captivating examples of zoological landscape painting, and illustrated with the beautiful figures so characteristic of Leidy. But it is in the latter paper that the young author shows his natural bent toward experimentation and toward generalization. In an introductory section on the "laws of life in general," he mentions experiments which he had carried out, on spontaneous generation; on endosmosis; and on the effects of ingesting infusoria and bacteria. In the latter he tried on himself the somewhat hazardous experiment of swallowing water containing, as he says, "*Monas, Vibrio, Euglena, Volvox, Leucophrys, Paramecium, Vorticella*, etc.," but with no detectible consequences. It was in this paper too, that he gave, six years before the publication of Darwin's *Origin of Species*, his famous statement of the doctrine of evolution; of his belief in the origin of the organic from the inorganic, and of the general course which he conceived the development of the animal world to have followed. This striking statement should perhaps be quoted in any general characterization of Leidy's zoological work. He says:—

"An attentive study of geology proves that there was a time when no living bodies existed on the earth. . . . Living beings, characterized by a peculiar structure and series of phenomena, appeared upon earth at a definite, though very remote, period. Composed of the same ultimate elements which constitute the earth, they originated in the pre-existing materials of their structure. . . . The study of the earth's crust teaches us that very many species of plants and animals became extinct at successive periods, while other races originated to occupy their places. This probably was the result in many cases of a change in exterior conditions incompatible with the life of a certain species, and favorable to the primitive production of others. . . . Probably every species has a definite course to run in consequence of a general law; an origin, an increase, a point of culmination, a decline and an extinction."

Such statements, made in 1853, bring again to realization, what we sometimes forget, that what Darwin did was not to propound a new idea, but to give overwhelming evidence in favor of a theory that was familiar to all intelligent students, and that was held by many of them. In his later works Leidy largely restrained himself from any tendency to generalize; one wonders whether from conscious principle, as from something cheap and easy. Experimentation also becomes infrequent, though it does occur. One suspects that if Leidy had lived in the period when biology became more analytical, he might have become another Driesch, or Morgan.

Other detailed portrayals of nature are found in his work on the anatomy of the terrestrial gastropods, in Binney's "Terrestrial Mollusca;" and in his papers on *Urnatella*, on *Belostoma*, on the walking stick, on *Corydalus*, on marine sponges.

But for zoologists his great masterpiece is the volume, the *Fresh-Water Rhizopods of North America*; some consideration of this will bring out the characteristics of his zoological work. In general, scientific books and papers are among the most evanescent products of human activity. The advance of knowledge soon renders them out of date: they continue to live only in that they have supplied nutrition to their successors. But such a work as "Leidy's Rhizopods" brings to realization the fact that perhaps the most permanent form of scientific literature lies in a full and accurate portrayal of some part of nature, without analyses of problematical matters, without hypotheses or generalizations. Generalizations soon become inadequate; experimental and statistical analyses are

superseded, or become useless, when once the conclusions on which they bear have been established or disproved. But an adequate account of a group of organisms in its relations to the rest of nature is like an adequate description of anatomy, or like the working out of some of the constants of nature, like the computation of a table of logarithms—of each of these we can say that when 'tis done 'tis *done*; it need not be done again. This seems the case with "Leidy's Rhizopods;" it is a section of nature permanently preserved to us. From the first it was, and it will remain, a delightful guide to acquaintance with these strange and beautiful creatures, which sum up in miniature the riddles of life. The student with a microscope, a pond, and "Leidy's Rhizopods," need envy the pleasures of no man in the world. And thousands of students have been in this happy situation; no other influence has been so potent in promoting acquaintance with the natural history of these lowest of animals. Even without the pond and the microscope, the volume is, for its illustrations, a delight to the artistic eye. But much more than all this; although zoology has become more analytical since Leidy, such a portrayal of nature is not left behind; it becomes only the more valuable. It presents to us with direct vividness the problems which nature sets, and it becomes a quarry of materials for work on those problems. The fundamental questions of biology—the problems of metabolism, of movement and behavior, of development, of reproduction, of heredity,—come sharply to a point on the activities of the protoplasmic substance; here many students are directing their efforts. But conclusions in general biology and general physiology are often vitiated by the narrowness of the base on which they rest. A phenomenon is studied minutely in some one organism, and the conclusions drawable are held to be general laws of nature; whereas they are often but special peculiarities of that particular creature. Nowhere is this common error more easily fallen into than in connection with the lowest organisms, as I know to my cost.

Protoplasmic movement, for example, is indeed shown in *Amoeba* of the *proteus* type; and here zoologists usually study it and draw conclusions concerning it. But Leidy will show it to you occurring in many other naked protoplasmic masses differing greatly from *Amoeba proteus*; in *Amoebae* with tough skins, almost unchanging forms, and rolling motion; in *Dinamoeba*, with its seemingly permanent outer layer studded with projecting points; in

the gossamer-like branching and net-forming *Biomyxa vagans*, which compared to *Amoeba proteus* seems almost as simple as does *Amoeba proteus* compared to an insect. I still recall the feeling of awe which this organism gave me the only time my microscope came across it, while following Leidy as a guide. *Amoeba proteus* when adequately studied doubtless does contain the secret of protoplasmic motion; just as the flower in the crannied wall contains all the secrets of God and man. But its outward manifestations of that motion may be gross and specialized peculiarities; I personally believe that they are. The student of that subject could not do better than take Leidy as his guide; study minutely protoplasmic motion in the extremely diverse types which he presents; in the various species fitted for the study of special points. Only so is there a chance to distinguish special peculiarities from general laws of protoplasmic movement.

This is typical of the situation with respect to other biological questions; with respect to nutritional problems, to the conditions of existence, to developmental and genetic problems. The student who tries to keep alive and to cultivate the various creatures of Leidy's pages finds the different ones so narrowly dependent upon particular nutritional conditions, and on other conditions, that he becomes skeptical of general nutritional laws based upon the study of one or two kinds of animals. In relation to genetic processes and problems, Leidy's work is particularly alive and suggestive. He presents us in unrivalled figures and descriptions a vast assortment of different forms, exemplifying every degree of diversity. He classifies these, he distinguishes individual differences, varieties, species, genera, families, orders. What do these things mean genetically? Leidy tells us that in these creatures he believes that "no absolute distinctions of species and genera exist": that he finds the species "by intermediate forms or varieties merging into one another." In his accounts of particular species, he often emphasizes that they do thus merge by intermediate forms into others: also that within the single species or variety there are great variations of structure. What is the observational or experimental content, potential or actual, of these propositions? Does the "merging into one another" of two species mean that the individuals of one may and do produce at reproduction individuals of the other? If not, what does it mean? Are the individual diversities, are the so-called different varieties, to be found among the descendants of a

single individual? Or are such diversities hereditary; permanent throughout the generations? Or may there be a process of gradual change, so that only after many generations may one variety be obtained from the other; or only after many generations may one break into several? What part does the environment play in all this?

These questions press upon us in studying Leidy as they do when we study nature, but, like nature, he gives us no answers to them. All may be attacked by simple and direct methods, and positive answers may be obtained; for most of the questions long periods of time are not required. The animals must be dealt with individually; cultivated individually, their pedigrees kept from generation to generation, as we do with rats; they must be handled as we handle rabbits. This can be done: it has been done for a few of Leidy's organisms; but only sufficiently to open up a vista of vast extent for future work. Some of the individual diversities within a species, it is found, have no hereditary basis; a parent of one type produces offspring of another; the environment may play a large part in determining which shall occur. But this is held within definite limits; and other individual diversities within a species *are* permanent and handed on from generation to generation. Each species contains numerous slightly but permanently differing strains. The so-called varieties do not produce one the other, and individuals of one so-called species do not produce individuals of the other. The merging into one another of which Leidy speaks is therefore not an experimental, a genetic concept. Yet by long continued breeding for many generations, single strains are seen to gradually differentiate into slightly diverse ones, strains whose diversities are thereafter inherited from generation to generation. How far may this go? We do not know; as yet one "species" of the systematist has not been produced from another; nor even perhaps one "good" variety. I fear that we are still in the situation which Leidy summarized in 1853, when he said that "No one has ever been able to demonstrate the transmutation of one species into another,"—even for species which he described as merging into one another.

Such work and other work must be carried out and greatly extended for all the different types which he describes. Their different methods of reproduction must be determined; we know almost nothing of their sexual processes or in most cases whether such

exist. The nature and results of their seemingly inchoate, imperfect form of conjugation must be discovered; the details of their cytological processes worked out. Until all these are carried out to some level of attainment, the significance of the observations along the other lines must remain uncertain. For all this research, Leidy's work is a mine of suggestions, and an indispensable guide. Many others of Leidy's contributions are similarly basic and suggestive.

But these examples must serve for many. In the brief time available I have attempted only to emphasize and illustrate the vitality of such work as Leidy's. In spite of the fact that it does little in the way of analysis and generalization, that it answers few general questions—perhaps indeed in virtue of that fact—it partakes somewhat of the inexhaustibleness of nature.

AFTERNOON SESSION

(At the Academy of Natural Sciences of Philadelphia)

CHAIRMAN—DR. CONKLIN:

I think we have all been gratified at the very large attendance of delegates from distant institutions,—the distinguished body of scientists who have gathered here to pay honor to the memory of Joseph Leidy. As I said this morning, we cannot do anything for Leidy, but he can do much for us. By this meeting we are really helping to perpetuate his influence and his personality. Professor Cope told me on one occasion, that Leidy hadn't any very great desire for immortality in another life; he had found this life sufficient and satisfactory." Well, there is an immortality right here on earth. Leidy rests from his labors, but his works do follow him, and it is that his work may go on, inspiring and stimulating others, and it is that as much as anything else, which justifies such meetings as this. We cannot break with the past; we must not forget the great debt that we owe to those who have gone before. Science is coöperative, if it is anything; there is no progress without coöperation, and we must recognize the great debt that we owe to those who have broken the way for us.

The first speaker this afternoon will be Professor Scott, who will speak upon Leidy's contributions to palaeontology. Leidy was really the founder of vertebrate palaeontology in America. This was undoubtedly the work which brought him his greatest renown,

both here and abroad. One-third of all his published works were in the field of palaeontology.

Professor Scott, in a very happy way, combines many of the qualities which were found in so remarkable a degree in Joseph Leidy. It is a little difficult to classify Professor Scott. He is a good zoologist, a good palaeontologist, a good geologist. I have great pleasure in introducing Professor Scott, President of the American Philosophical Society, and Professor of Geology in Princeton University.

DR. WM. B. SCOTT,
PRINCETON UNIVERSITY.

Palaeontological and Geological Work.

Before I begin what I have to say on the subject of Leidy's work as a palaeontologist, I think you would be interested to hear a letter, or at least a part of it, which I received some weeks ago from Sir Archibald Geikie, Secretary of the Geological Society of London, and for many years Director of the Geological Survey of Great Britain. In asking me to represent the Geological Society of London, of which I have the honor to be a member, he wrote this note that I am sure you will be glad to hear:

"On the part of the Geological Society I am desired to inform you that we have been invited to send a delegate to the meetings that are to be held in connection with the commemoration of the Centenary of Joseph Leidy, by the Academy of Natural Sciences of Philadelphia in December next. As Foreign Secretary I am desired to write you and express the hope that you will honor us by being our representative at the Joseph Leidy Celebration.

"The writing of this letter reminds me of my close intimacy with Joseph Leidy and the many friendly letters that passed between us. Should there be any representative of his family at the celebration in December, would you tell them how cordially I join in doing honor to the memory of one whom I revered and loved?

"With best wishes for your health,
Very truly yours,

ARCHIBALD GEIKIE."

I may be pardoned, I hope, for continuing a moment or two on the personal note which this letter strikes. Osborn and I, in our senior year at Princeton—I ought to call him Professor Osborn I suppose, but it is difficult to speak respectfully of one's classmates—you see we know them too well. We spent a large part of our senior year getting ready for the first of the expeditions to the Far West, as our hope was to get into the Fort Bridger country

of Southern Wyoming. That immediately brought us into a study of Leidy's great monograph, published a little while before by the Hayden Survey, into attempting to learn what we were going to find in that country, and that went further to personal communication with Dr. Leidy. And after we had been in the Fort Bridger country in the summer of 1877 and made a large collection there, we spent a large part of our graduate year—1877 to 1878—in working up that collection, and we were constantly running to Philadelphia, and to the Academy, to see Leidy's types, to compare our material with that which he had described and named, and to ask his advice and his help. And, though we were mere tyros, beginners, utterly insignificant, he was invariably as kind and considerate and thoughtful, and as lavish in the gift of his time, as though he had had nothing else to do. I look back to those early years, when I began my professional career after having been in England and in Germany and had come back to resume my work at Princeton,—I was constantly coming to see him, constantly referring problems to him for his consideration. Always, invariably, I got the help I wanted, and it was in such a contrast with the attitude of mind of many other distinguished men of science of that day. They were very "standoffish," many of them,—they held you at arm's length and would tell you just as little as they could. I remember asking one very prominent palaeontologist whether there were good collecting grounds at a certain region in Kansas. "Well," he said, "there were before I got there." That was all the satisfaction I could get out of him. Leidy wasn't a bit like that. What he had was yours, if you asked him for it. He had that sweetness and gentleness of personality that are so attractive when united with greatness. I have known a few great men in my life, and without exception they have been men of extraordinary simplicity, without any airs, or graces,—without any "side" as our English cousins put it. Huxley was another like that, only, living in London, he had to protect himself more than Leidy did here, because if he hadn't put a fence between himself and the public, he would have had no time for his work.

That is the note I want to leave with you, namely that of extreme simplicity of character, of kindness, of helpfulness, of feeling that his time belonged to anyone who asked for it, if the object of that asking were not mere frivolity, but honest work.

It is a curious thing that both in Great Britain and in the

United States the medical profession was, until well into the nineteenth century,—in fact the latter third of it—the only doorway to the study of zoology and palaeontology. In England, the two greatest names in vertebrate palaeontology that immediately stand out to anyone who knows anything of it are Owen and Huxley. Both of them studied medicine. Huxley began his career as a ship surgeon, and made a long voyage in a naval vessel, which was as significant for his future as was the voyage of Darwin. The observations that he made on that voyage made a zoologist of him. Also, he did high-class palaeontological work.

Owen did perhaps more than any other man who ever wrote English in the volume and variety of the work which he published in vertebrate palaeontology. He, too, began as a student of medicine, and his father-in-law, Dr. Cliffe, induced him to take the Curatorship of the Museum of the Royal College of Surgeons in London, from which he gained that amazing knowledge of comparative anatomy which made him a natural student of palaeontology. The treasures which began to pour into England during the middle of the nineteenth century, from various exploring expeditions, were collected not only in Great Britain but throughout the world, and were mostly sent to Owen for description. The same thing was true in this country. All of the early palaeontologists were medical men, and it is therefore no mere coincidence that the center of palaeontological work in this country, other than that of shells,—invertebrate animals—was in Philadelphia. The first of them was Dr. Wistar,—Casper Wistar, whose name is held in such well-deserved reverence in this city yet, and the Wistar Institute is named for him.

Then there was Dr. Harlan,—then came Leidy. Over in New York the same thing was true. The two naturalists who were most prominent in New York were Dr. Samuel L. Mitchill, a most extraordinary all-round person, and a person I may say, because I am connected with his family, perhaps the most conceited man in the North American continent. He translated the "Theory of the Earth," and he said he did it at the request of President Jefferson who, he says "remarked to me on one occasion that I was the only man in the country able to do it,"—and he didn't add anything to that. He thought it was enough. "But," he thought, "I agree with Jefferson."

Samuel Mitchill was Senator from New York, and also was a

very distinguished physician and one of the earliest of New York naturalists, in the description not only of fossils but also of the living fauna of the State.

Dr. James DeKay,—I hope he didn't pronounce it the way it is spelt. (I see I can't get this off as my own because the gentleman who gave me the facts is present in the audience, Dr. John M. Clarke, the very distinguished Superintendent of the Geological Survey of New York and the State Museum). I wrote him the other day and asked him a simple question, and he just showered information on me,—namely that DeKay, who had charge of the botany and the zoology of the great New York Survey, was also a physician; and DeKay is one of the first men, I think, who ever described an American fossil horse. Thus, naturally enough, Leidy fell into the tradition because his tastes were that way, his interests were that way, and as early as 1833 Sir Charles Lyell, the founder of modern Geology, was in this city and he visited Leidy and told him, "Stick to palaeontology. Don't bother with medicine. Stick to palaeontology. That is your future." Well, Leidy didn't take his advice. In fact, under the conditions of those days it wouldn't have been feasible for him to do so because, like most of us, he had his living to make, and it could not be made by palaeontological work.

Throughout his life, Leidy primarily was interested in human anatomy, and he remained, almost to his death, Professor of Human Anatomy in the Medical School of the University of Pennsylvania; but he felt always that man was only one of the vast multitude of animated beings. He told me once, laughing in that gentle way of his, of a student who came to him after a lecture and said, "Now you don't really mean, Professor, that man is an animal?" and Leidy answered, "Do you think he is a vegetable?" And therefore he extended his work as we have been told this morning, in all possible directions. Everything that lived had a fascination for him and he wanted to learn not only its exterior appearance, and its habits, but he wanted to know its structure, and in this way, quite unintentionally, he fitted himself to become the pioneer of vertebrate palaeontology, which he was.

Now I could, of course, go on for a week, if necessary, if you just had the courage and patience to stay and listen, telling you a lot of technical details, but I have not the slightest idea of doing anything of the sort. It is Leidy's early history that I want to point

out to you, and I think this audience, which is not composed of palaeontologists entirely, is more interested in the influence which he had in the development of this subject in America, which has become the supreme area of palaeontological work, especially in the vertebrates, throughout the world. Such things have their reason or explanation and this great development has taken place because of the vast material which this continent possesses. My friend Osborn has been lately getting over into Asia and finding equally great treasures there, and the expeditions which have just come back from China have brought us incredible and delightful treasures. Some of you heard of them in the newspapers. They have found dinosaur eggs. I hope they won't make any attempt to incubate those eggs, for it would be a misfortune to have dinosaurs on earth again. We are well rid of them.

In a cave near Natchez, in Mississippi, certain bones were found. It was thought that they were human bones, because in those days and for a long time afterward every bone was human. There was a man who went through the South with a mastodon skeleton that he had mounted like a man, on two legs. The top of the skull was gone, so he restored the skull with a piece of rawhide like a human skull, and exhibited it from town to town as the skeleton of a giant. And he had a trunk full of certificates from doctors in good practice that these were human bones.

Well, these bones that were found in the cave were sent to Leidy, and they turned out to be the bones of a curious ground sloth, and it is interesting to note that it was with the ground sloth that American Palaeontology began. They were described by Thomas Jefferson in 1805; that is, the volume of the Philosophical Society's Transactions appeared in that year—the paper, I think, was written about 1797, and in it he stated that he imagined that this clawbone of a gigantic sloth to be that of a gigantic lion. It wasn't much of a blunder. The resemblance is close and Jefferson, of course, was an amateur. He didn't pretend to be anything else, but it is a paper that is full of interest from many points of view. I am sorry that my time does not permit me to tell you something about it.

Then the giant ox tribe attracted Leidy's attention and he published a monograph on that. He published a monograph on the peccaries that were found in various parts of the country. Now you never find them north of Texas.

Those surface things naturally came to him, but the things upon which his greatest reputation rests, I think, are the materials found in the Tertiary deposits of the Far West, notably in those beds which we have come to call the White River formation of Nebraska, because in those days Nebraska occupied all that northwest territory, including the present Dakotas and Kansas. It was a general term for that uninhabited region.

In the year 1849, I think it was, Dr. John Evans found some White River specimens and sent them to Dr. Leidy, and in the following year, an undergraduate of Princeton, Thaddeus Culbertson, who was afflicted with tuberculosis, had been ordered to go West by his physician, and he was advised by Professor Baird who was then Assistant Secretary of the Smithsonian Institute, and said to this young man, "Go to the White River country and collect fossils and send them to Leidy, because Leidy is the only person in the country capable of dealing with them." Leidy published a number of papers on these fossils and then, in the year 1853, he gathered them together in one report, illustrated with the most beautiful lithographic plates, I think, that have ever been issued in any publication in America. They were made by a Swiss artist, Sonrel; and they are unrivaled in their beauty of execution. Still more comprehensive was the great work published by the Academy here in the year 1869, and those works form the starting point, really, of our knowledge of the White River fauna, and we have been collecting there ever since. Expeditions go into the White River country every season, I think, but we have done very little except to fill in the sketch which Leidy outlined.

He was the first man to show, for instance, not only that there were native horses in America, and, as we were told this morning, the first American rhinoceroses. He found also the first of American camels, and it was shown that this line of camels, incidentally, began here in America.

My time is running out and I want to say just one or two more words. This was followed by his work on the Bridger formation,—the older beds of Southwest Wyoming, and in the year 1877 he made his first visit to those Bad Lands and he wrote a most vivid description of the Bridger Basin. It shows what a geologist was lost in him, if he had had the opportunity to turn to that kind of work. He then published the first of the works on Upper Cretaceous reptiles in Montana, and the Upper Cretaceous fauna of

the Atlantic Coast. There is mounted in the Museum of this Academy the first dinosaur skeleton that was ever put together in America. There is a lot of conjectural restoration,—in fact, as put up by the late Waterhouse Hawkins, an English scientific man, not so very scientific, but known more for being artistic—the head is entirely grotesque, but it is the first time an attempt to put a dinosaur together was ever made and it is Leidy's dinosaur, described and named by him, from the Cretaceous of New Jersey. So, you see, he laid broad and deep the foundation upon which the great structure of American vertebrate palaeontology has been erected. Why did he get out of it? There were two different reasons. They were both true, and one of them he didn't care to speak about much in public. Those of us whose hairs are gray or whose heads are devoid of hair, will remember the bitter quarrel that existed,—a feud—between Professor Marsh and Professor Cope. They succeeded Leidy to a certain extent, and they hated each other with the most deadly hatred. Both were rich men, and so they diverted the stream of fossils from Leidy. As Leidy told Geikie, "I have got to get out because when anybody found a fossil they used to send it to me and I got it for nothing. Now today Cope and Marsh pay money for such things and I can't compete with their long purses." That is true enough. That is one reason. There was another reason which I don't think he ever expressed in public, but he did express it to me, and I have no doubt to many other people. He said, "I can't stand this fighting. It disgusts me and I am going to drop Palaeontology and have nothing more to do with it, because of the way Marsh and Cope are in each other's wool all the time." And yet he couldn't stop. Some of the last work of his life was done in describing the fossils from the phosphate beds of South Carolina, and later still those from Florida. And it is a very interesting coincidence that one of the first things he described from the White River beds of Nebraska was the saber-toothed cat,—tiger as we call him, which was about two feet high; and one of the last things he did before his death was to describe the termination of that tiger series in the great beast it became in the Pleistocene.

This is a most inadequate sketch of a vast subject, but you will easily see that you cannot put a quart into a pint pot, and you can't describe a great character in fifteen minutes, but I hope I have left with you the impression that Leidy's work is the foundation

upon which all subsequent American vertebrate palaeontology has been built.

CHAIRMAN—DR. CONKLIN:

Professor Scott, the applause of the audience warrants the conclusion that they would have been very glad to have had you go on with the very charming talk you have given them, with all the personal touches which you were able to give.

Our next speaker is to be Dr. Witmer Stone, the Chairman of the Board of Curators of the Academy of Natural Sciences. He is an inheritor of the great Leidy tradition, not merely in that he also occupies the same post which Leidy so long held in this Academy, but also in the breadth of his knowledge, and his interest. It is very difficult for any of us to classify Dr. Stone. He is a zoologist, he is an ornithologist; but also he is a botanist, and he is to speak to us upon the botanical work of Dr. Leidy.

DR. WITMER STONE,

THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA.

Joseph Leidy as a Botanist.

I have been asked to say something of Joseph Leidy as a botanist. Doubtless many of you will be surprised to learn that Dr. Leidy was a botanist—or at least that he had a knowledge of the flowering plants, a field in which he published almost nothing. That he possessed this knowledge in a high degree, however, is attested by his associates and by the manuscripts and herbaria that he has left us. Indeed there were few of his contemporaries who were better acquainted with our local flora than Leidy, and we have here simply a case where publication was no measure of the man's knowledge.

Curiously enough I first heard of Dr. Leidy as a botanist, and it was in that connection that I thought of him before I ever met him or learned of his work among the extinct vertebrates, the rhizopods, or in the field of anatomy. Our family physician at the time of my boyhood happened to be the late Dr. James Darrach, an intimate friend and botanical associate of Dr. Leidy, and himself an authority on the flora of the Philadelphia district. With my budding interest in local plants Dr. Darrach was most sympathetic, and to further stimulate it told me many a tale of botanical ex-

cursions with Leidy about the suburbs of the city, and in the pine barrens of New Jersey.

It seems that botany was really the first branch of science to which Joseph Leidy's attention was attracted and desirous of acquiring some knowledge of it he secured a text book and began the formation of a herbarium; one of his first collecting fields being a lot on the site of the old Reading Railroad depot, then at 9th and Green Sts.

It is probable that he never lost the interest then acquired, as we have the testimony of those who were accustomed to tramp with him about the country that he always returned from a walk with a bunch of botanical specimens gathered from woodland, field, or roadside.

The study of medicine and microscopical research in other lines, together with absorbing studies in palaeontology, occupied so much of his time from 1840 to 1856 that there was little time for botanical activities. In this latter year, however, apparently through a suggestion of Dr. LeConte that Academy members should pay more attention to the local fauna and flora, a little coterie of botanists began to meet regularly at the Museum to discuss and compare specimens of the local plants. They called their gathering the Botanical Club, and its members were: Charles E. Smith, Aubrey H. Smith, James Darrach and Joseph Leidy. From the labors of these men came the notes that appear, here and there, in the early editions of Gray's "Manual" relative to the Philadelphia district, and how much Gray owed to them in elucidating difficult systematic problems will never be known. That he valued their opinions very highly we may infer from a letter from Charles E. Smith to Leidy in January 1880. He writes: "I have a letter from Gray asking my opinion about a change in the plan of a new edition of his manual. I want to consult you before answering it; it is important and I do not feel inclined to give crude advice. Come help me."

Most of the intensive study carried on by these men was the work of Charles E. Smith and Leidy, and was credited to Smith—owing no doubt to the inherent modesty of Leidy, and to the fact that Smith was apparently chosen by the group as their mouthpiece. In the Charles E. Smith herbarium are numerous most interesting bits of manuscript containing descriptions of obscure species, notably of grasses and sedges, with opinions as to their identity and relationships, signed "C. E. S.," followed by other comments

over the initials of Leidy, and Dr. Thomas C. Porter, these latter often consisting merely of the statement "I agree," or similar note of acquiescence.

Another letter from Leidy to Smith illustrates his keen perception, as he had correctly identified a Kentucky coffee tree, apparently seen only in winter, and about which there seems to have been some difference of opinion. He says under date of June, 1881: "The *Gymnocladus* at 6th and Walnut is all in its glory. It looks like a large wide spread *Ailanthus* for which perhaps you took it."

Not a few botanists familiar with the conspicuous flowering plants pass by the grasses and sedges, but not so Leidy. His notes on the old herbarium specimens show conclusively that he was as well acquainted with these orders, as with any of the showy groups more easy of analysis.

He made a new herbarium at the time of these studies to which he kept adding up to the time of his death, and which he left to the Botanical Department of the University of Pennsylvania, where it is still preserved, representing some 1500 species. From a study of these specimens, and the scattered notes to which I have referred, there is no doubt but that at the time that this intensive study of the local flora was in progress there was, with the single exception of Charles E. Smith, no one more thoroughly acquainted with the plant life of the vicinity of Philadelphia than Joseph Leidy.

His knowledge of the flowering plants, moreover, extended beyond the limits of the Delaware Valley and the New Jersey pine barrens; and we have preserved in the Academy's herbarium collections made by Leidy in the Fort Bridger region, Wyoming, and in the Uinta Mountains, Utah, while he was searching for rhizopods in 1872. In 1880, too, he made a trip to Roan Mountain, N. C., in company with Dr. Porter and Mr. Thomas Meehan, and collections of plants were made there jointly. In papers describing rhizopods and other lower forms of life obtained on these expeditions, we can realize from brief introductory statements the enthusiasm which the array of new flowering plants must have aroused in the mind of Leidy. "Some of my most delightful recollections," he writes, "are associated with expeditions into the Uinta Mts. . . . At elevations of from 8000 to 10000 ft. the mountains are covered with forests, chiefly of Fir and Pine, with a wonderful profusion of beautiful flowering plants beneath." And again regarding the southern Alleghanies: "The top of Roan Mt. forms an extensive

grassy pasture with broad patches of the beautiful *Rhododendron catawbiense* and bordered with forests of Firs, *Abies canadensis* and *A. fraseri*. The floor of the forest, made up of broken granitic and gneissoid rocks and fallen tree trunks, is thickly carpeted with a luxuriant growth of mosses conspicuously decorated by the Wood Sorrel (*Oxalis acetosella*). Chief among the mosses, each apparently attempting to outrun the others in the exuberance of its growth, were the three pretty Hypnum; *H. splendens*, *H. crista-castrensis* and *H. triquetrum*."

Dr. Leidy's only actual publication on flowering plants in addition to these brief comments related to a new station for the hybrid Bartram's Oak in New Jersey. But Leidy's interest in botany was by no means limited to the phanerogams. Indeed so far as publications go he stands almost exclusively as a cryptogamic botanist. This doubtless came about largely from his interest in microscopy, and the search for rhizopods and other minute forms of animal life naturally brought him in contact with diatoms and desmids, and various species of moulds and other fungi. All of these he drew with great care and fidelity, and many of his beautifully delicate drawings are preserved in the Academy's library. The president of the Academy, Dr. Penrose, informs me that, as a boy, when Dr. Leidy and Dr. Darrach visited his father, he frequently drove them about the marshes below the city, where the ditches were explored for minute forms of animal and plant life, which were ladled out, as Leidy describes, in a special tin dipper, and carried home in glass preserve jars.

Many species of cryptogams were described in the Academy's PROCEEDINGS while one of Leidy's most notable publications, his *A Fauna and Flora within Living Animals*, was the culmination of this line of research. In it he described the host of minute animals and plants dwelling in the digestive tracts of a large beetle, *Passalus cornutus*, and our largest myriapod, *Spirobolus marginatus*, both of which I have collected under the bark of fallen tree trunks along the Wissahickon, where Leidy doubtless obtained his material.

My personal acquaintance with Dr. Leidy covered only the last years of his life. I well remember, while a student at the University of Pennsylvania, attending a lecture which he delivered in old Association Hall at 15th and Chestnut Sts., under the auspices of the Students' Scientific Society. His subject was "A Glance at the

Lowest Forms of Life," and, lantern slides not being yet in vogue, he used large drawings displayed on an easel depicting various species of cryptogams, rhizopods, and the like—drawings which won my profound admiration. Next I remember visiting him in his home on Filbert St., with a letter of introduction from Dr. Daniel G. Brinton, when I was applying for a position on the Jessup Foundation at the Academy. I can still clearly see his fine profile as he stood by the bowed window at the back of the parlor reading the letter. Then he asked me kindly about my studies in ornithology and botany, while he explained the opportunities offered at the Academy if one had the proper kind of interest in natural history.

Then came the frequent meetings with him at the Academy in the old library on Race Street. He was then our president and presided at the Tuesday evening meetings, when impromptu communications were made and discussed by those present. I was always deeply impressed by Dr. Leidy's wonderful ability to comment instructively upon practically any point that was brought forward, no matter in what field of science. I realized that here was not merely a palaeontologist, not merely an anatomist, not merely a botanist, but a naturalist in the broadest and finest sense of the word; and I wondered then, as I still wonder today, whether, after all, such a man does not confer as much upon science, whether he is not better able to handle the broader problems, than the narrower specialist to which class most of our present day scientific man of necessity belong. Undoubtedly such a man gets more of the joy of living from having, as did Dr. Leidy, a speaking acquaintance with all nature, than if he traveled the path of life with many of the byways closed against his entrance.

Dr. Leidy had a great reverence for nature. A natural object was not a mere specimen to him, but something to be treasured; and scientific research was not a mere seeking after knowledge, but a field sacred to those who knew how to pursue it with proper appreciation of what they were doing. It seems as if the flowering plants more than anything else exemplified this feeling and aroused to the highest pitch that admiration of nature which filled his mind.

It is told of him that at a public dinner he once exclaimed in admiration at the beauty of the floral decorations, referring to the flowers by their scientific names, and some thoughtless guest said:

"How do you remember such long words?" which so wounded Leidy's sensitive nature that he determined never to attend such functions again. And during his last illness, at the time of year when the early spring flowers were bursting into bloom, someone sent him a bunch of *Arbutus* which he held in his hand and exclaimed "the beautiful *Epigaea*!"

Perhaps his reverence for flowers was responsible for his treating botany, to quote his own words, as his scientific playground. Perhaps he preferred to enjoy them with a few friends rather than to spread his knowledge of them, in dry technical terms, before the world.

It is rare enough to find a palaeontologist who is also a microscopist; or a botanist who knows both the flowering plants and the cryptogams; and still rarer to find a zoologist who is also a botanist, and yet Leidy was all of these.

To borrow from the terminology of the geneticists Leidy's knowledge consisted of dominant factors, which formed the basis of his published works, and recessive factors, which covered fields of knowledge upon which he could have published but did not. He says himself in regard to further publications on the rhizopods that he was in doubt: "I may perhaps continue in the same field of research," he writes, "and give to the reader further results but cannot promise to do so, for though the study has proved to me an unceasing source of pleasure, I see before me so many wonderful things in other fields that a strong impulse disposes me to leap the hedges to examine them." Had he but leaped the hedges that bounded those fields of alpine flowers to which he so briefly alludes, and published some of the store of botanical knowledge with which his mind was filled, I should have had a different story to tell today; and prominent among the leaders of botanical science in America would have stood, as it does stand among the leaders of zoological science, the name of Joseph Leidy.

CHAIRMAN—DR. CONKLIN:

The Academy of Natural Sciences was the scientific home of Joseph Leidy. For forty-six years he was an officer of this Academy, first as a librarian and curator, then as Chairman of the Board of Curators, and for the last ten years of his life as President of the Academy. It was here that at the weekly meetings he made those numerous communications, some of them only a few lines in

length, others of greater extent in which he commented upon the acquisitions that came to the library or the museum, as well as upon his own work. This was then, as I have said, the scientific home of Joseph Leidy. The University was the field of his daily labors, but this represented the place where he had his recreations, and his pleasures to a very large extent. And I cannot help but feel—and what I am saying to you I am saying without having consulted the president at all, and I hope I shall have his approval in saying it—I can't help feeling that the Academy ought to have some memorial of Joseph Leidy that would not only perpetuate his memory, but prolong his influence, and that would make it possible for potential Leidys in the future to follow in his footsteps. It seems to me that one of the large lessons that might be drawn from this very representative meeting of scientific men from all over the country is that people who love the truth, and who respect those who give their lives for the advancement of knowledge, should make it possible by means of financial foundations to continue in the largest possible measure the influence for good of such a man as Joseph Leidy. I have taken the opportunity of dropping this word in the hope that it may reach the ears of someone who may see the great opportunity which is offered here.

Our last speaker for the afternoon is Prof. Frank W. Clarke, Chief Chemist of the U. S. Geological Survey. He is also Honorary Curator of Minerals of the United States National Museum. He is known throughout the world for his work on the earth's crust, honored in all lands, one who knew Leidy, and who can tell us of his work in mineralogy.

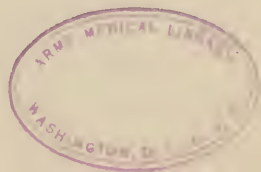
I have pleasure in introducing to you Prof. Clarke of the United States National Museum.

PROFESSOR FRANK W. CLARKE,

CHIEF CHEMIST OF THE U. S. GEOLOGICAL SURVEY.

Mineralogical Work.

The subject assigned to me is the mineralogical work of Dr. Leidy, and that assignment has led me to think just what that means. What is mineralogy? To say that it is the study of minerals only covers a small part of the ground. If you would look at science in general, you will find that every branch of it owes something to some other science—has a point of contact with some other



science, and that is particularly true in mineralogy. The science of mineralogy touches many other sciences very very closely. For example: Suppose you find a mineral, what are its geological associations? Is it from sandstone, granite, or what? What is the chemical composition of the mineral?—there you touch chemistry. What is its crystalline form?—there you touch geometry. What are its properties, such as color, and its optical properties in general? There you are dealing with physics, and so on along the line. It even touches, I might say, botany, because amber, which ranks as a mineral, is a fossil resin from a species of pine. In fact, I think I might say that mineralogy is a branch of palaeontology, for everywhere you find a mineral is a fossil record of the chemical reactions by which it was formed. The palaeontologists may think that this is rather straining a point and perhaps it is.

Now a mineralogist, in the strict sense of the word, is one who has particularly devoted nearly all of his time to that one science, which has to deal with all these different phases of the existence of minerals, and very few men living, can cover the whole ground.

Now Dr. Leidy made no pretense to completeness of knowledge in such directions; so far as I can find out, he described no new species; he certainly made no analyses of minerals, he made no complete crystallographic measurements, and yet he did much that is of the greatest service to mineralogy in various directions. If you look at his record as a whole, I think that you will see that mineralogy came into his life partly because of his general interest in everything referring to natural phenomena and partly because of his aesthetic tendencies. He not only made a study of minerals because of their beauty, but he made a specialty of the study of cut gems, and there I think it was this beauty that attracted him rather than their scientific relations, although he worked wholly on a scientific basis. I find in looking over his publications, and those relating to mineralogy are not numerous and are not always easy to locate, his communications are mainly to the Academy of Natural Sciences, and mostly, as far as the records show, essentially informal. He would get hold of some interesting minerals, exhibit them to the Academy, and describe them. Sometimes he went further and gave longer accounts of them. For instance one of his first papers, although not strictly mineralogical, was, the "Crystals in Plant Tissues." Then he described, quite fully indeed, the corundum of Unionville, Pennsylvania. Then he

had quite a long paper in the PROCEEDINGS of this Academy on the structure of Mexican opals. A good many of these papers, perhaps twenty or thirty of them, are extremely brief, and only a few more than a page in length. Incidentally he had to take up the question of that very peculiar mineral, so-called albertite, from New Brunswick. Dr. Leidy was called to testify as expert in connection with it. I will say for those who are not informed that albertite is one of those curious bituminous substances about half-way between petroleum and coal, neither one nor the other, but looking and behaving outwardly more like coal than anything else. It is a very queer substance.

Now a large part of Dr. Leidy's work was in collecting and distributing minerals. He built up the collection of minerals of Swarthmore College, which unfortunately was destroyed by fire. He did much for the Wagner Free Institute of Science and for the Academy, as well as the University, and he also had a good deal to do in the way of exchanges with the British Museum. He was reaching out for interesting things all the time, and he was the means of distributing them. He was also in intimate association with other collectors especially here in Philadelphia,—Vaux, Bement, Willcox, and many others. They used to meet frequently at Mr. Bement's, on Spring Garden Street, and I was able to be present on several occasions. They usually met on Sunday afternoons, and the meeting was sometimes called their "Sunday School," and it was very edifying.

Dr. Leidy, as I said a little while ago, was a gem expert and that is saying a good deal. It is surprising to find how few jewelers have any right to claim that title of gem experts. Every jeweler knows empirically a few of what you might call the more popular gems—the diamond, the sapphire, the pearl, the ruby, etc. But when it comes to the more unusual gems, you will find very few jewelers who know anything about them. Now Dr. Leidy covered the whole ground, and his collections were, therefore, exceedingly valuable. The first that I knew about was a very beautiful collection which was sold to a Boston dealer, W. J. Knowlton. He was a competent man, but unfortunately instead of having that collection kept together, as Leidy would have wished, it was sold piece-meal.

The collection Dr. Leidy possessed at the time of his death was partly one of cut gems, and partly of uncut minerals, and it so

happened that those collections passed into my custody. Just at that time I was engaged in preparing exhibits for the government for the exposition at Chicago, and a certain amount of money was at my disposal for the preparation of those exhibits. I was able to buy of Dr. Leidy his gem collection and also his mineral collection, and one of the last things he did before he died was to pack the collection of gems for transmission to me. The minerals were packed after he had passed away. They are now in the National Museum in Washington, and it may be interesting to call attention to the fact that a similar collection, left by Dr. Isaac Lea, is also there in the National Museum, side by side with Leidy's. It is, I suppose, unfortunate for Philadelphia that they did not remain here, but it is a very good thing for the National Museum.

Now you see, Dr. Leidy did not pass as a mineralogist. He didn't claim that title, because, as I said before, mineralogy was a side issue with him, but this we can say, that the chief outstanding feature of Leidy's mineralogical work was *service to others*.

DR. PENROSE:

Joseph Leidy Memorial Medal.

I have been asked to announce the creation of the Leidy Medal Foundation. This foundation has been presented in trust to the Academy of Natural Sciences of Philadelphia, in commemoration of the centenary of Joseph Leidy by his nephew, our distinguished fellow member of today, Dr. Joseph Leidy, 2nd. Under the terms of this foundation the medal is to be presented, every three years, as a reward for preëminent research work in any of the branches of the natural sciences. The Academy of Natural Sciences of Philadelphia deeply appreciates this generous contribution to the encouragement of research work.

CHAIRMAN—DR. CONKLIN:

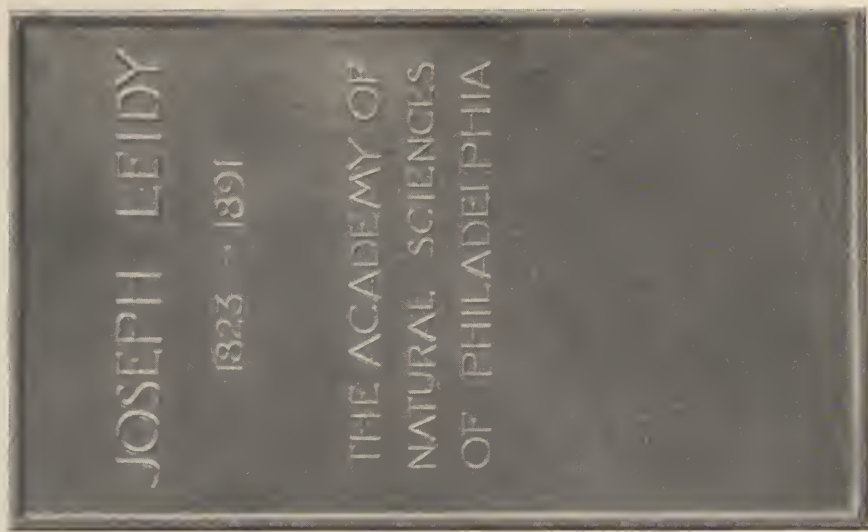
This session stands adjourned and we meet again, at the College of Physicians, at 8:15 this evening.

EVENING SESSION

(At the College of Physicians of Philadelphia)

CHAIRMAN—DR. PENNIMAN:

Ladies and Gentlemen. We are met to-night in the Hall of the College of Physicians and Surgeons in the name of the University



FACSIMILE OF THE JOSEPH LEIDY MEMORIAL MEDAL

of Pennsylvania, to commemorate the Centenary of the Birth of one of America's greatest scientific men, Joseph Leidy. Throughout the day, beginning at noon, scientific meetings have been held at the Academy of Natural Sciences in further commemoration of this notable anniversary. But we are not merely commemorating the centenary of Joseph Leidy. We are commemorating it in a special way by assembling to hear the third of a series of "Joseph Leidy Memorial Lectures in Science," under the Auspices of the University, and on a foundation established in 1912 by Joseph Leidy, Jr. The thought of the founder was that these lectures should be given annually, although from time to time, a year may be permitted to pass, but that in alternate years only may an American be invited to be the speaker, and we have an American as our speaker tonight.

Two years ago we had Professor Wilson of Columbia University, and last year Professor Bateson of the John Ernest Horticultural Institute of Merton, Surrey, one of the greatest genetic biologists of the day.

Joseph Leidy was connected since his graduation in 1844 from the Medical School of the University until his death in 1891 with that institution as Professor of Anatomy. His scientific work was previsioned by the title of his graduation thesis, to which I have heard more than one distinguished scientist refer as "The Comparative Anatomy of the Universe."

In 1853 Leidy was elected to the Chair of Anatomy in the University. He was a prolific writer, an extraordinary power as a teacher, an outstanding figure, compare him with whom you will in the history of science in all nations. Over five hundred books appeared from his prolific pen, and as was said of him, though an anatomist, botany, geology, palaeontology, and mineralogy, were all fields with which he was conversant and familiar.

The distinguished lecturer of 1923 is Professor Henry Fairfield Osborn, President of the American Museum of Natural History, known throughout the world for his contributions to scientific knowledge in the fields of palaeontology and evolution. Professor Osborn has only within a very brief period returned from extensive travels in the Orient, and he speaks to us tonight not quite extemporaneously, but without that elaborate preparation which scientific men regard sometimes as an absolute prerequisite to the utterance of their choicest thoughts in the choicest words. But we

are profoundly grateful to Professor Osborn for coming to us, and I have the great pleasure of presenting, as the third Leidy lecturer, Professor Osborn.

HENRY FAIRFIELD OSBORN,

VERTEBRATE PALAEONTOLOGIST, UNITED STATES GEOLOGICAL SURVEY.

*Joseph Leidy, Founder of Vertebrate Palaeontology in America.*¹

I ask the indulgence of the members of this gathering in honor of Joseph Leidy and fellow workers in the fields of science if I present what I have to say in an informal manner, and I trust that you will not for a moment imagine that because it is presented informally I do not appreciate the honor conferred upon me in asking me to speak on this historic occasion in reference to a man for whom I have such great admiration as for Joseph Leidy. I shall not repeat, except in a very general way, the homage that was paid to Leidy in the series of important and penetrating addresses which we have listened to today, but I shall endeavor to present a summary, especially along the lines of palaeontology and comparative anatomy, of some of the distinctive features of his work in comparison with those of the men who accompanied and immediately followed him, and to show what great results have come from his efforts as a pioneer and as a founder of this most interesting and fascinating branch of science in America.

Leidy started with an entirely new world of life; he soon learned that he could not base his study of American fossils on the work of French palaeontologists, for the life of our western regions was not known in the Old World. Every specimen represented a new species or a new genus or a new family, and in some cases a new order. Never was there a greater opportunity than was offered to Leidy in this virgin field of our then virgin West. Never was a man more ready to grasp it than that quiet, unpretentious, unassuming,

¹ The Joseph Leidy Lecture in Science under the University of Pennsylvania Foundation. Extemporaneous address at the Joseph Leidy Centenary, Philadelphia, December 6, 1923.

Two previous addresses have been given in this series: "Heredity and Microscopical Research," by Professor Edward Beecher Wilson, of Columbia University, April 17, 1913; "The Segregation of Genetic Types," by Professor William Bateson, of the John Innes Horticultural Laboratory, January 24, 1922.

wonderfully gifted observer of nature. It is particularly interesting to review his work, which was written in the exact spirit of Cuvier, and to see his long record of direct observation of the entire extinct fauna not only of the eastern but, especially, of the great western territories. We find today how permanent that work was; how little we have to modify it; how well it stands the test of time; how accurate are his descriptions; how perfect his figures and illustrations; and how even today they form admirable standards for all the work that has been done since. After a continuous series of epoch-making papers and contributions which he was in the habit of contributing year after year, at meeting after meeting of the Academy, he brought his initial work to a climax in 1869, when he published his great monograph *Extinct Mammalian Fauna of Nebraska and Dakota*. That work still ranks in breadth and accuracy as the finest single contribution that has been made to vertebrate palaeontology in this country, if not in the world.

Whereas in Leidy we had a man of the temper of the exact observer type, Cope was a man who loved speculation. If Leidy was the natural successor of Cuvier, Cope was the natural successor of Lamarck. Leidy, in his contributions to the Academy, covered the whole world of nature from the Protozoa and Infusoria up to man and he lived as the last great naturalist in the world of the old type who was able by both capacity and training to cover the whole field of nature. Cope, in contrast, mastered—and this mastery in itself was a wonderful achievement—the entire domain of vertebrates from the fishes up. Marsh, with less breadth and less ability, nevertheless was a palaeontologist of a very high order and had a genius for appreciating what might be called the most important thing in science. He always knew where to explore, where to seek the transition stages, and he never lost the opportunity to point out at the earliest possible moment the most significant fact to be discovered and disseminated.

It is most interesting to contrast the temperament of these three men, Joseph Leidy, Edward Drinker Cope, and Othniel Charles Marsh. They were as different as any three men could possibly be made, both by nature and nurture. As Professor Edward Smith said in one of his addresses on Leidy, "Scientists are only mortals after all." Your scientific genius may hitch up with a star on the one hand and with an anchor on the other. Whereas Leidy was essentially a man of peace, Cope was what might be

called a militant palaeontologist. Whereas Leidy's motto was peace at any price, Cope's was war whatever it cost. I do not know that I can find from Shakespeare any characterization of Joseph Leidy, but I think in *Henry IV* there is a pretty good characterization of my friend Edward D. Cope:

"I am not yet of Percy's mind, the Hotspur of the north; he that kills me some six or seven dozen of Scots at a breakfast, washes his hands, and says to his wife, 'Fie upon this quiet life! I want work.' 'O my sweet Harry,' says she, 'how many hast thou killed today?' 'Give my roan horse a drench,' says he; and answers, 'Some fourteen,' an hour after,—'a trifle, a trifle.'"

Perhaps there was a scientific providence in all this; perhaps such antagonistic spirits were necessary to enliven and disseminate interest in this branch of science throughout the country. This subtle combative quality in a palaeontologist is a strange quality; it is a strange inversion, because the more ancient and difficult the study, the more refractory the fossil, the greater the animation of discussion regarding its relationships. From this subtle ferment there arose the famous rivalry which existed not between Leidy and either of the others, because it was impossible to quarrel with Leidy, but between Cope, the descendant of a Quaker family, and Marsh, the nephew of a great philanthropist. When I took up the subject as a young man and first came to the City of Brotherly Love I always expected to learn of some fresh discussion, some recent combat; it was even in the shade of the Academy of Natural Sciences that one found echoes of these convulsive movements. I remember one day coming into the dignified halls of the Academy and finding two of the youthful attendants engaged in hot discussion over a dispute they had overheard at a meeting of the Academy the night before.

Leidy, after the characterization that we have heard of his life from Conklin, Jennings, Scott, and others, occupied a pivotal position, a very interesting pivotal position. He was in an intellectual environment and more or less in a social environment entirely different from our own. This is very important to keep in mind in estimating his work. In spirit he was, I think, a true pre-Darwinian in the sense of seeking what may be called facts for Darwin and in the breadth and scope of his researches. But he lived in an entirely different intellectual atmosphere from that which surrounds our scientific world of today; he was a John the Baptist for Charles Darwin. We must remember that twelve years before

Darwin brought forth the *Origin of Species* this young man was beginning to assemble a mass of data which would have been of great value to the great British naturalist. As shown by Professor Scott, he was tracing the ancestral lineage of the horse, the camel, the rhinoceros, the tapir family, and last, but not least, of the titanotheres, a matter to which I shall return.

Nevertheless Leidy was an evolutionist *sub rosa*; he was an evolutionist without ever using the word Evolution. There is no doubt about that when you read a citation from his writings such as was selected by Professor Jennings:

"The study of the earth's crust teaches us that very many species of plants and animals became extinct at successive periods, while other races originated to occupy their places. This probably was the result, in many cases, of a change in exterior conditions incompatible with the life of certain species and favorable to the primitive production of others. . . . Living beings did not exist upon earth prior to their indispensable conditions of action, but wherever these have been brought into operation concomitantly, the former originated. . . . Of the life, present everywhere with its indispensable conditions, and coeval in its origin with them, what was the immediate cause? It could not have existed upon earth prior to its essential conditions; and is it, therefore, the result of these? There appear to be but trifling steps from the oscillating particle of inorganic matter to a Bacterium; from this to a *Vibrio*, thence to a *Monas*, and so gradually up to the highest orders of life! The most ancient rocks containing remains of living beings, indicate the contemporaneous existence of the more complex as well as the simplest of organic forms; but, nevertheless, life may have been ushered upon earth, through oceans of the lowest types, long previously to the deposit of the oldest palaeozoic rocks as known to us! !"

This really is a sketch in 1847 of environment and survival such as we now know to be the actual course of evolution and was truly anticipatory of modern results, substituting modern language as we may do for the quaint phraseology of the period.

On the subject of the evolution of man especially, Leidy certainly had very clear and positive ideas. He caught from Goethe the significance of the occasional reversion and the embryonic suture between the premaxillary and maxillary bones—constituting a single bone in the human subject, two bones in the lower order of mammals. He pointed out this suture in 1847, in the skull of a native from one of the Hollander Islands. In 1849 he pointed out the separate embryonic condition of the intermaxillary bones. In both cases, as was his habit, Leidy obviously saw the significance but, always sticking to facts and a presentation of facts, he let the matter rest there. The most pronounced adumbration, however,

of the evolution of man from the primates is to be found in a citation of his volume of 1873, a period when the descent of man was still not recognized. "But little change," he said, "would be necessary to evolve from the jawbone and teeth of *Notharctus* that of the modern monkey. The same condition that would lead to the suppression of a first premolar tooth in continuance would reduce the fangs of the other premolars to a single one. This change with the common teeth shortening and the increase of the depth of the jaw would give the character of the living South American monkey. A further reduction would give rise to the condition of the jaw in the Old World apes and in man."

I do not need to point out that the human jaw, next to the human forehead, is the most significant feature in the transformation from the lower to the higher primates. But some of those here present may not know that a monograph has been written by my successor and colleague, Professor William K. Gregory, upon the genus *Notharctus* Leidy. Gregory fifty years after this significant passage was written by Leidy chose *Notharctus* as an ideal intermediate type to place in a theoretic ancestral series leading up to man, and in the beautiful series of preparations which he has recently completed showing the development of the human face in all stages from the most remote ancestral facial type to the modern human face Gregory uses *Notharctus* as the pivotal point, just as did Leidy fifty years ago.

To return to the matter of Leidy's intellectual environment, how much we owe today to our intellectual environment, how much we owe to battles which have been fought and won over insufficient evidence—not battles of words, but battles of facts. Such evidence as that of *Notharctus* the alert vision of Leidy detected and put in its proper place. In those days "mum" was the word as regards evolution. Neither Cuvier, nor Owen, the British successor of Cuvier, nor Louis Agassiz, great naturalists all, had accepted the theory; theologic influence was still all-powerful. Fortunately for Leidy, William Jennings Bryan was still in embryo. Trying to form an historic parallel of William Jennings Bryan, I think it may be found in the figure of King Canute sitting with his court on the shores of Nature, trying to beat back the waves of Truth. If Leidy had lived in the era of Bryan he undoubtedly would have been classified with Professor Conklin and myself—he

would have been made with us a type of a new genus and species, *Anathema maranatha*, in which, according to the zoology of Bryan, are embraced "tall professors coming down out of trees who would push good people not believing in evolution off the sidewalk." Leidy would not have been burned at the stake only because of legal obstacles. Similarly I think that Professor Conklin and myself owe our lives to the fact that auto-de-fés in matters of belief are no longer matters of common practice in our civilization.

It is perhaps particularly fitting that Professor Scott and myself were asked to speak at this Centenary for one reason above others. We have been the defendants and supporters of the Leidy tradition. I am not quite sure, but I doubt if you will find in the writings of Professor Cope or Professor Marsh a single allusion to the work of Leidy. I make this statement subject to verification, but I do not recall in their writings a single allusion to the work of Leidy; the rivalry between the two men went to such lengths that in their race with each other Leidy was totally forgotten. Every new animal that was discovered was given a new scientific name by each of them. *Notharctus* Leidy, for example, is exactly the same animal as *Tomitherium* Cope and *Limnotherium* Marsh. Thus arose a trinominal system—three names each of the Eocene and Oligocene animals—the original Leidy name and the Cope and Marsh names. It has been the painful duty of Professor Scott and myself to devote thirty of the best years of our lives trying to straighten out this nomenclatural chaos. Even to this day we are verifying the observations of Leidy; we find that he never made an incorrect observation, or published an incorrect figure; his accuracy in these regards is one of his greatest and most permanent claims to immortality as a palaeontologist.

I do not know that I altogether agree with my friend Conklin in his address as to the relation of extensive and intensive work. If I understand him aright, he rather implied that intensive work is an inevitable feature of modern scientific progress. I would rather cite Leidy as an example of a man who pursued intensive work and extensive work simultaneously and who had the capacity to pursue intensive work in several branches of science, biological and geological, and I would regard the permanence of Leidy's work as largely the result of the state of mind produced by the breadth of his intensive as well as of his extensive work. I would like to leave on your minds my conviction, buttressed by Leidy's life, that it will

be necessary even for those of our day to maintain the Leidy attitude, because after all it is in the single mind that *great hypotheses and theories are generated*. The comparative anatomist, if he dies out, will leave human anatomy impoverished. Today our medical students should return to the Leidy attitude, as Professor Scott said, of entering palaeontology by way of medicine and base our education in human anatomy, as Leidy did, on a broad knowledge of comparative anatomy. This is only one instance out of very many that might be given of the legacies of Leidy to us, namely, that throughout his life his mind had continuously the intensive as well as the extensive attitude. He was able to be on the mountain tops and then descend into the valleys, and I believe that while some men who pursue one subject intensively all their lives are making great discoveries, for example such workers as Professor Michelson, whom we all honor, the chances are that few men can make great discoveries unless they approach the subject broadly and work from more than one angle of thought.

Speaking of immortality, I rather share the Leidy view than the view of Cope. I wish it were possible to resurrect Joseph Leidy and to bring him back into the field of modern American palaeontology. I wish it were possible to bring him back to life and to have taken him with me, for example, in a motor car across the wastes of Mongolia. I can imagine the joy with which he would have welcomed coming upon the remains of the land dinosaurs, recalling his first description of a dinosaur in America, in the very heart of the great Desert of Gobi. And perhaps the still greater joy with which he would have greeted one of his titanotheres, one of the first mammals which he described from Wyoming, out on a great plain on the border of the Desert of Gobi.

The desire for this kind of immortality reminds me often of the Greek poet:

To live like Man and yet like Nature to endure,
That double gift to man and nature both denied
The Gods alone enjoy.

We are rewriting this beautiful Greek verse in the immortality of Leidy's work, and we are holding up his example for the prevailing spirit of truthfulness which is, after all, its most characteristic single feature. Would that Leidy and Huxley and Richard Owen and Cuvier and Marsh and Cope could see the heights which have been reached in the branch of science to which they devoted their

lives and fortunes. Leidy's infant science, in which it was most hazardous to make predictions, has now reached the stage which I believe is the finest in the history of any science—the stage of prediction—that as astronomers have predicted the existence of unknown and unseen planets, palaeontologists can also predict unknown and unseen forms of life and, more, can point out where they may be found.

Is our palaeontological path reaching its goal? I think not. Its final goal will be reached when palaeontologists are able, through extensive and intensive methods, to join hands with workers in other biological fields, and when we are able, pursuing our branch in the Leidy spirit, to bring together into one harmony, the harmony which certainly exists although at present we do not see it, by bringing together into one harmony the great underlying principle, the multiple aspects of which we can sum up in the word Evolution.

CHAIRMAN—DR. PENNIMAN:

We are still to hear this evening some personal recollections and appreciation of the work of Leidy as an anatomist, by two of the most eminent living medical men, both citizens of Philadelphia, and both for a time students of the great master.

I have the pleasure of presenting first to this audience, Dr. George E. de Schweinitz.

DR. G. E. DE SCHWEINITZ,

UNIVERSITY OF PENNSYLVANIA.

*Reminiscences of a Prosector and Appreciation of Leidy's
Work as an Anatomist.*

Number 56, Medical Hall, of the University of Pennsylvania was Leidy's room. Here America's greatest descriptive anatomist for years assembled his material and prepared it for his demonstrations and lectures on human anatomy, with a precision and an exactitude which always distinguished the manifold activities of his notable life. The kindly western light, shining through the windows, illuminated this historic workshop, even as did the presence of him concerning whom some words shall now be spoken. It is the purpose of this brief address presently to invite you to visit this room in order that you may watch the master at work, and to endeavor with the aid of a few biographical incidents to interpret

some of the characteristics of the man in whose honor this meeting takes place.

Wherever Dr. Leidy travelled abroad—and he was under thirty years of age when he paid his first visit to European countries—his fame had preceded him; his welcome was secure; to miss his call was a grief. On one occasion, when he visited Huxley, who was not at home, Mrs. Huxley entertained him. Shortly afterwards came this letter: "Dear Dr. Leidy: Once Mrs. Huxley saw an iceberg on which rode a polar bear, a sight I have never witnessed. Now that she has seen Leidy and I have not, there will be no living with the woman." This little story, loved by his students, was by many believed to be apocryphal, but it seems that Dr. Leidy's nephew is in possession of a letter which indicates that, shorn of the polar bear, the anecdote is authentic.

A good many years ago, while conversing with Professor Blanchard, the distinguished French parasitologist, he was asked for a card of admission to the anatomical rooms of the *École de Médecine* in order that the preparation of the cadavers for dissection might be witnessed. The favor was readily granted, with a question as to the reason for this request. Receiving an answer that since the days of prosectorship to Dr. Leidy, interest in practical anatomy had never waned, Blanchard delightedly exclaimed, "What! were you Joseph Leidy's prosector? His books and monographs I have," pointing to the well-laden shelves of his library, "but him I have never seen. I must converse with you and hear intimately of the man for whom I have so great an admiration." Dr. Blanchard never tired of hearing of Dr. Leidy,—his methods of work, his surroundings, his personality. Leidy's name was an "open sesame" to the feelings and sympathies of those to whom his wisdom and learning appealed.

But this appeal did not alone reach the men of science with whom he consorted. The utter kindness of his nature made the same appeal to all who came in contact with him, layman and doctor, assistant, and servant.

As a diener Leidy had a man named Nash, whom, after his convalescence from a broken thigh, he took from the wards of the Pennsylvania Hospital. It was commonly believed, and no one who knew him ever doubted it, that Nash had been a pirate on the high seas. He remained a pirate to the end of his life. He would have been a man of might in the good old days on any rakish craft

which ever sailed the Spanish main. Over six feet in height, he had a hideous face, covered with a grizzled beard, but his devotion to Leidy was that of a collie dog to its master. Stamping around the laboratory, he was a tower of strength, and neither man nor devil could have entered Leidy's room had Nash forbidden it.

Unhappily, the first dissection the prosector made for Dr. Leidy was of the face—a female cadaver at that. Would that he had lived, thought the prosector, in the days when to dissect a woman was a crime and to dissect a face forbidden. The task at last completed, Nash was called, with the question, “Look at that, will it pass?” He glared at the work with his great, bloodshot eyes, until impatiently the novice spoke again, “Well, what do you think of it?” “Think of it,” came the scornful, growling reply, “I have a bull pup at home that can do a ——— sight better.” A little furious, but none the less chagrined, for Nash was himself a skilful dissector, the prosector waited for the master, even though he dreaded to hear the sound of his approaching footsteps. He entered with a cheerful “Good morning,” looked for a moment at the uncovered head and without a word turned it, placing the undissected side of the face in position, and in an incredibly brief space of time exposed the delicate muscles until they resembled a plate in “Gray's Anatomy”. Turning to the abashed and envious prosector, he asked with a gentleness that was peculiarly his own, “How long have you been dissecting?” “A year or two” was the reply. “And I,” he said, “for twenty-five years or more. The knack of it will come to you as it came to me, sooner, I think.” Do you now understand why those who worked for Leidy loved him?

Dr. Leidy's gentleness, the gentleness and sweetness of disposition which seem to belong to those who spend much time in studying nature and her works, he lent to his judgments when in the circumstances he might readily have been pardoned for making them harsh. On one occasion the lecture of the day required a dissection of the acromial, anterior and posterior scapular, and the anterior and posterior humeral regions. Judged by the Leidy standard, the dissection was far from satisfactory, indeed, practically useless for the kind of demonstration purposes required. Just as the prosector began to realize that he had failed in any resolve “to leave no rubs or blotches in the work,” the professor entered the room, with swift eye taking in the blunder which had been

made, but except for a muttered "my, my," said nothing. He quickly turned to another subject upon another table, and with characteristic rapidity repeated the work which on the first cadaver had been marred. Distressed and humiliated, the prosector watched, ashamed to offer help, when suddenly Dr. Leidy began to chuckle (he was at that time working on the posterior humeral region in the neighborhood of the common tendon of the triceps) and between his chuckles this is what was heard, "Once when I was Horner's prosector, I dissected the aponeurotic laminae off of the posterior surface of the triceps, and just as I had nearly finished Horner came in. My, my, but he was mad." Could any one have asked for a more comforting softening of a blow than that? Horner was "mad," but not Dr. Leidy, who deftly and gently restored the ebbing self-respect of an inexperienced youth, even as he would have restored a wriggling amoeba that was getting out of focus to a more favorable light on the stage of the microscope.

He had the gift of extricating those who got into awkward situations, either stupidly, ignorantly or unconsciously, as the case might be, and always gently. Often people came to his laboratory, sometimes on business, but frequently drawn there by that type of curiosity which makes some men and some women cross doorways unannounced. Once an old man tottered into the room. He was bent, grizzled, and gray, and was distinctly of the country. Dr. Leidy, as usual, greeted him with a cheerful "Good morning." Slowly the old man approached the table where work was being pursued, and said, "I was just looking around here. I went to the medical college when the school was down on Ninth Street. A man named Horner taught us anatomy. He is dead, I suppose." "Oh, yes," said Dr. Leidy, "he has been dead for many years." Continuing, the old man remarked, "At that time there used to be a young fellow there who was always dissecting, like that young man over there (pointing to the prosector). I have often wondered what became of him." "Was his name Leidy?" he was asked. "I don't know," said the old man, "what his name was, but it may have been that." "Well," replied Dr. Leidy, "he kept on working, and after Dr. Horner died he took his place and became Professor of Anatomy of the University of Pennsylvania." "You don't say so," said the old countryman, with the utmost astonishment, entirely unconscious of the fact that he was that moment speaking to the young man who was "always dissecting,"

and who was now one of the world's greatest anatomists. He was gently encouraged to slip into a reminiscent mood, and equally gently bidden "good bye," for time was precious. The prosecutor could scarcely restrain himself, and when the countryman had left, he said "Why in the world did you not tell him who you were?" "What was the use," he replied, "it probably would have embarrassed him, although it might have meant nothing to him."

On another occasion a very different type of man came in—a youngish man with his hat on the back of his head, a lighted cigar in his mouth, placed at an angle which is figured in comic papers when they portray some ward politician. This was too much for the prosecutor, who flew out of his chair and said, "Take off your hat, and take your cigar out of your mouth; throw it away; you are in Dr. Leidy's private room." He was in full retreat, when Dr. Leidy called him back, now hat in hand and cigar eliminated, and gently soothed him, questioning him as to who he was, and why he was there. He departed with a pleased grin on his face, and an awkward salutation, neither of them for the prosecutor. Dr. Leidy turned and said, "My, my, you have a bad temper." He forgot that for this assistant to enter his room was to "take off your shoes from off your feet, for the place whereon you stand is holy ground." and so in defence he replied, "But, Dr. Leidy, a disrespectful intrusion like this could not be tolerated." "It may be," he answered, "that he was a specimen worth studying! we might have found out something very valuable. Only yesterday I paid ten cents to go into a museum on Arch Street. I saw five curiosities, two cents apiece. Now this young man was a curiosity, and he did not even cost me two cents."

Dr. Leidy was prompt in his correction of an inaccurate impression he had received, or of a faulty opinion he had formed. Once a mutual acquaintance was discussed, who in his early days had made a fine study in experimental pathology, but who never later added to or repeated efforts in this respect. Mildly criticising, Dr. Leidy expressed his regret that so promising an entrance into the field of research work had been abandoned, that the man, as he expressed it, had been tempted away to a more lucrative calling. This led to a discussion on the estimate that should be placed upon clinical investigation as compared with laboratory research, and when the argument, if it may be so described, was concluded, Dr. Leidy replied, "You are right; I have been unjust in my judg-

ment; I am so far removed from all clinical work that I failed to realize the character of the examinations required in the establishment of a diagnosis; they, too, represent a type of research work of the highest importance," and, be it remembered, this was at a time when the coöperative work of the laboratories and the clinics was not as intimately interwoven as it is today.

It must not be supposed because, to use a homely expression, Dr. Leidy was "good-natured," he failed to express himself, when required, in sharp and robust criticism. Rarely he spoke harshly, but when, like all quiet, silent, unassuming men, he was moved by what he considered, and very properly considered, dishonorable conduct, to make known his opinion, there could be no possible mistake in the meaning of the words he employed. His contempt for slovenly work was the contempt that any great man who has never been guilty of it in all his life must necessarily have, a contempt which was increased if the offender departed from the strict paths of scientific rectitude and the ethical conduct of his profession.

When on occasions Dr. Leidy's almost invariably smooth temper was ruffled, occasions on which most men would have broken the third commandment, his favorite expression, as may have been inferred, uttered usually as he walked up and down his laboratory, was "my, my." This mild epithet was occasionally hurled at the head of some luckless student, for he was obliged to examine a great many of them who ought to have been turned over to his juniors. Among these were the dental students, who were required to take examinations in general anatomy; and be it remembered that at that period dentistry had not attained the heights to which it has now risen. These dental students cared nothing about anatomy, except in so far as it pertained to the jaw, and were only too frequently ill-prepared. Entering his laboratory one day, a dejected student was encountered in the doorway. Dr. Leidy tramping the floor in characteristic attitude, muttering his "my, my," looked up and said, "What do you think, I asked that man where the arch of the aorta was and he didn't know. I did not ask him any more questions." Kind and considerate to students, too kind, sometimes, his limit of endurance had been reached.

Dr. Leidy was modest, always unassuming, but this modesty was never permitted to interfere with what he considered was proper respect for his position in the University when in any sense that seemed to be challenged. Just because he was quiet, lesser

lights in science sometimes imagined that he could be imposed upon, especially in the allotment of hours, and in the evaluation of the departments over which he presided. This he never for a moment permitted. He knew what his duty was to the students. He knew how many hours it was right and just he should have, and not one of these hours would he ever permit to be taken from him, or submit to the slightest abrogation of any of the rights which pertained to his chair.

Often it has been asked "What did Dr. Leidy talk about?" Almost never about himself and his discoveries, in the ordinary sense of these words. Of course, if questioned, he told of his explorations and expeditions, of his walks in the woods, of the ponds he searched for the lower forms of life, of the many problems brought to him for solution, of the great men he knew and had met. Sometimes he regretted that he had failed, being perhaps over-cautious, to record observations he had made, for instance, that of the amoeboid movements of the white corpuscle. Sometimes he seemed a little hurt that certain discoveries of his own had been passed, or had received only scant notice, not because *he* had been neglected, but because *they* had not attained their proper place in the sum of human knowledge.

Of books? Oh! yes, quite often. Once his prosector asked him who his favorite novelist was. "Ouida," was the reply, much to the questioner's astonishment, who found it difficult to understand why Dr. Leidy should have been entertained by the prismatic descriptive language of that distinguished authoress.

He was fond of talking about the vagaries of spiritualists and of mediumistic phenomena—he was at that time a member of the Seybert Commission, with whose report you are familiar. He had the gift of telling the story of nature and her secrets, lucidly, delightfully, entertainingly.

Almost never during those days was he heard to refer to religion or religious matters—only once, indeed, as far as memory now reaches, when he told how he had been approached by some stupid but well-meaning person, who, rather deprecatingly, asked if he would be willing that a prayer should be said on the occasion of his address to the graduates in medicine of that year. Somewhat irritated, he said, "Why should I object?" and himself requested a distinguished Unitarian clergyman to perform that function. Charles Pfender is quite correct in saying that Dr. Leidy felt an-

noyed at the implied reproach of infidelity by self-sufficient persons who exploit their so-called religion in lip service to the Deity.

If he had marked prejudices, "pet aversions," as we are wont to say, he rarely, if ever, exhibited them. One, rather amusing at that, did find expression, namely, his objection to having "Grace said before meat." Not that he objected to a "Grace" in itself. "Why should the Deity," he was wont to exclaim, "be thanked for food which must be taken in order to live, any more than he should be thanked each time we put on our clothes, which we must do to protect ourselves from the cold and obey the ordinary rules of society, or before we take a bath, which the laws of cleanliness and hygiene require." But often for long periods he was silent, busy with his work, busy with his observations.

While in the ordinary meaning of the term Dr. Leidy's sense of humor was not especially keen, it was far from lacking, and he had no mean skill in "slyly poking fun" at those with whom he was conversing. To his laboratory came all manner of things, fossils, bones, minerals, insects, animals, usually dead—sometimes the place was almost a charnel house. Entering his room one morning, he was found with a letter and piece of bone, slightly charred, in his hand. This bone had come from a mound, and was supposed by the sender to belong to some extinct species. Handing the prosector the specimen, he asked, "What is this?" "A piece of bone," was the reply. "Oh yes," he replied, "of course it is a bone, but from what animal did it come?" Professing ignorance, he proceeded to make plain why he believed it was part of the femur of the common North American black bear, the *Ursus americanus*. An hour or more passed in silence, the dissection proceeding busily, when suddenly he questioned thus: "Do you know any Latin?" "A little," was the answer. "Recite something." By the grace of heaven, the closing lines of the sixth book of Vergil were remembered, and when the sonorous hexameters were ended, he asked their origin. Receiving the information given in all innocence, he peered over his spectacles, a merry twinkle in his eye, and said, "It seems to me you know the books of Vergil better than you do the book of nature. Study the latter even more accurately than you have the former."

On another occasion, as work was proceeding on opposite sides of the dissecting table, he, dissecting out the long saphenous, and the prosector cleaning up the external cutaneous nerve, endeavoring

to find the communication which usually exists between this nerve and the long saphenous near the knee-joint, the scissors which were being used slipped, and a branch of the nerve was severed. Now Dr. Leidy objected very much to a dissecting technic in which scissors were employed; he was very skilful with a scalpel. Hoping and believing he had not observed the slip, the prosector looked round for a piece of string and mended, as unobtrusively as possible, the divided nerve. Presently, to the infinite joy of the sinner (it was near the lecture hour and the professor was pressed for time), his knife slipped and divided the piece of nerve which he was holding in his forceps. For a moment nothing was said, when Dr. Leidy looked up, and a little meekly, but none the less with a twinkle in his eye, questioned, "Have you got any more of that string left?"

Dr. Leidy's room has been referred to as a "workshop;" it was indeed. There a table with his writing materials and he busily making notes; there another table with many specimens neatly covered with dampened cloths, but one being accurately studied with his observing eye; there a long slab on which rested a cadaver, and he with skilful fingers and amazing rapidity exposing the tissues,—muscle, nerve, artery, vein.

Association with Leidy brought many indelible impressions, and notable among them was his ceaseless industry. He was never idle. If, for example, the dissection had been completed ten or fifteen minutes before the bell announced the hour of the lecture, when most men, thus employed, naturally would have rested, Dr. Leidy always found something to do. A favorite employment during these few minutes was cleaning and polishing, and studying a larynx and trachea, which usually lay, covered, on a plate on his table. His nephew, who is with us tonight, surely remembers this larynx and trachea, carried so frequently during odd moments to his laboratory. It is probable that this specimen, ultimately prepared to his satisfaction, furnished the model for the front and back view of the larynx as they are illustrated in Figs. 308 and 309 in the Second Edition of his *Elementary Treatise on Human Anatomy* (1889), and that it is still preserved in the Wistar and Horner Museum of the University. Time was precious; he never wasted it, and this tireless energy was characteristic of him in every respect, and an inspiration to all who had the privilege of observing him.

Dr. Leidy's artistic skill is well known and remembered. Even as a child, not yet ten years of age, it was evident, and a small book

of "portraits of shells," to use the neat expression of one of his biographers, has been preserved; it bears the date of 1833. It is hardly necessary to remind this audience of the beautiful illustrations in his famous monograph on the rhizopods, reproductions of his own exquisite drawings.

But even more wonderful was it to watch him in his lecture room, stand before a large blackboard, and, without copy, rapidly and accurately sketch a section of the entire brain, portraying its regional anatomy; rarely has visual memory been more skilfully interpreted to the satisfaction of an admiring class of medical students.

It is an interesting fact that nearly one-half of the 495 illustrations in his *Elementary Treatise on Human Anatomy* are original, i.e., by Dr. Leidy and Dr. Schmidt. This gives some idea of the great amount of labor which he bestowed upon this book. Just a little incident to illustrate Dr. Leidy's devotion to accuracy. One of the duties of the prosector, while the second edition of the treatise on anatomy was going through the press, was to sit over a dissected cadaver and follow the descriptions of the tissue thus exposed, while Dr. Leidy read from manuscript or printed sheets. This technic, you will observe, was put into operation not merely for the purpose of "checking up" descriptions, but to ascertain whether they (the descriptions) conveyed to the student a satisfactory word-picture. If, and this sometimes happened, the dissection did not exactly conform to the statement designed to make known the appearances, the reading ceased, and Dr. Leidy either corrected the words which had been recorded, or, with a few swift cuts with the scalpel eliminated the defects in the exposure of the parts concerned. It constituted a high type of proof reading.

Lucky prosector, in that he was privileged to represent hundreds of students who soon were to become the beneficiaries of a book, which on every page gives evidence of the lucidity of expression, and of the revealing descriptive power of its author. But this book, modestly denominated an "Elementary Treatise" did not alone make an appeal to medical students. It occupied, for example, an honorable place in the reference library of Sir William Flower, Director of the South Kensington Museum, and at one time Curator of the Hunterian Collection of the Royal College of Surgeons. "I could not get along without it," said Sir William,

speaking to Dr. Leidy's nephew, "it is a constant source of assistance."

It is not the purpose nor the province of this essay to take into consideration Dr. Leidy's important studies and investigations in human anatomy. They might readily form a chapter which would in some respects, although less extensively, rival in interest those which are devoted to his researches in helminthology and parasitology, in zoology, paleontology, botany, and mineralogy. Witness his elucidation of the anatomy of the human larynx; his observations on the structure of the intervertebral substance in man; his investigations of the intimate structure of articular cartilage and that of the liver; his studies of the intermaxillary bone, and notably those of the temporal bone. The list is a long one; these are only a few examples.

Because the sweep of his thoughts and observations "touched the chords of the gamut of human knowledge, and made him a leader in the march of science," we are apt to forget his contributions to human anatomy, as, indeed, sometimes to his disappointment, they were forgotten in days gone by. But this we must not forget: In spite of the extent of his scientific activities, he never failed to remember the needs of his students, and never neglected to ease their overburdened memories. This desire one may well believe stimulated his efforts at the very beginning of his career as a teacher of human anatomy to reform the nomenclature of this department of medical education. He deprecated the "host of burdensome names," too often attached to different organs, requiring "an effort of the memory" to recollect them, entirely independent of the objects themselves. He had hoped, so he told his students in his introductory to a course in anatomy (published in 1853) to have a text-book ready for them as a guide in which all uncharacteristic names, where others exist as synonyms, should be left out of the text and placed in footnotes. It was not until 1861 that this hoped for book on anatomy was available, and in the second edition, published 28 years later, Dr. Leidy's effort to simplify anatomical terminology was even more elaborately renewed, always with the hope that such endeavors would prove to be successful in helping the student to acquire a knowledge of the subject. You see the student and his needs were ever favorite objects of his heart. This devoted interest in the student's welfare was an outstanding characteristic of the man. As one of his assistants said recently,

himself the head of an important department of anatomy, "Not alone on account of Dr. Leidy's intimate knowledge of the subject, not merely because of his unsurpassed power of portrayal, but largely because the student and his needs were always in the foreground, he was a good teacher." It is a homely phrase but a suitable one. Not only was Dr. Leidy America's greatest descriptive anatomist, but he was one of her great teachers of human anatomy.

After Horner's death, when he became a candidate for the vacant professorship in anatomy in the University, he encountered strong opposition. There was a broadcasting of all manner of accusations: "he is an infidel," said one, "an atheist," said another, "he has tried to prove that geology overthrows the Mosaic account of the creation," shouted a third, "he devotes too much time to scientific investigations, he is not a practitioner of medicine," and so on, and so on. Wellnigh incredible, is it not? No wonder he wrote to Baird: "Is this the nineteenth century, and do we really live in a land of civil and religious liberty?" Happily he could add: "Notwithstanding these discouragements, all of the medical profession warmly support me, every member of the Faculty at the University is favorable to and aids me, and the medical students held a mass meeting passing a most flattering resolution in my favor." Good for the medical students! he never forgot them; they will never forget him and what he meant to them.

A little story, and I'm done: Coming into his room one morning, Room 56, the prosector found him reading a letter. It was the announcement of the award of the Cuvier Medal. "Read that," he said. As the letter was returned with words of congratulation, although this assistant did not believe there was any medal in the world worth having which he ought not to have received, he asked, "Did you ever get a prize?" "Yes," was the reply, "the Hodge Medal for dissecting, and a thesis prize at the time of graduation." "Why then," he answered, with one of his peculiarly winning smiles, holding out his hand, "we have both gotten prizes." Can you imagine the delicious thrill that went to the very heart of that young man, included, as it were, for one rich moment in Leidy's class?

When Harvard bestowed on Dr. Leidy an honorary degree, President Eliot said: "Joseph Leidy, anatomist, zoologist, paleontologist, an exemplar among the men of science." Indeed he was

an exemplar among the men of science. We are intensely proud at the University because Joseph Leidy was with us and added to the lustre of our institution, perhaps more than any man who has ever been connected with it, but in a larger sense he belongs to no city, to no institution, to no country. He belongs to the great world of science, and science belongs to no city, to no country, to no institution.

Hence it is that we are glad we are here tonight; glad to have heard Professor Osborn's distinguished address; and being here, are glad to join together in "warming our souls at the fire of a common glory."

CHAIRMAN: DR. PENNIMAN:

We will now hear from another friend of Leidy, Dr. Hobart A. Hare.

DR. HOBART AMORY HARE,

JEFFERSON MEDICAL COLLEGE.

Leidy and His Influence on Medical Science.

When reference is made to the subject of Leidy and his influence on medicine, it must not be thought the word "medicine" refers to drugs, or remedial measures other than drugs, or, for that matter, necessarily to any part of the practice of medicine. The subject is in reality his relationship to the science of medicine, or, in other words, investigations which, founded upon fact and accurate observation, enriched that science in the sense of knowledge. All knowledge is valuable and it not uncommonly happens that an observation that seems to deal with what is called "pure science," pure in the sense of purity or accuracy of thought, or pure in the sense that it seems to have no practical application, is found subsequently to have a very definite and important bearing on the prevention, diagnosis, and treatment of disease. From this standpoint Leidy's influence was great even if to the bedside clinician it was meagre. But it may also be said that if practising physicians had received the god-given ability to make observation as "pure," in the sense that it is accurate, as was that of Leidy, an immense amount of good would have resulted in his day and in our own.

Those of us who were so fortunate as to sit at the feet of Leidy

as students of medicine appreciate today, more than ever before, the privilege we enjoyed; but I cannot avoid the thought that it is a subject for regret that no one let us know more of what his presence meant or, if this was not feasible, that his faithfulness to his task of teaching human anatomy, as it had to be taught in those days, prevented him from leading us at least along the edges of the pleasant pastures in biology that he enjoyed and cultivated. If these thousands of medical men could have been instructed not alone in plain human anatomy but given at least a vista of what lies beyond, how much happier and more interesting lives could they have led? How many of his pupils saw in anatomy something more than bones and blood vessels? How many, if they had only grasped the best phases of his mind, would have come, as he did, to the study of disease, not as a thing which must be combated to earn a living, but a study in natural history in that disease depends upon flora and fauna or upon changes in living cells induced by other causes. I, for one, feel today as if I had been with a great artist and never seen more than his tubes of paint when I might have seized the opportunity to see how he could turn the contents of those tubes into a picture of dazzling beauty. And this is not a mere figure of speech, because no one can look at Leidy's colored drawings of the flora and fauna of living animals without being impressed with the graceful beauties that he depicted, although to the ignorant those things are parasites and repulsive. I challenge any one to look at those pictures without giving an exclamation of wonder at the beauty they depict, and at the skill of the artist. Unfortunately for the average man the story is now all told, but for Leidy it was only the beginning of a phase of development and life. Slight though his influence may have been on the ordinary medical student, who sat in the presence of the master without knowing where he sat, may we not hope that even the most obtuse must have unconsciously been touched with the spirit of that master, and so learned from him the virtue of accurate observation and conservative judgment.

It may not be out of place before discussing further the influence of this remarkable man on the science of medicine to say something of his early days, because they were an earnest of his future career, and also because they afford an object lesson to those who would try to emulate his deeds. His nephew, Dr. Joseph Leidy, Jr., has given me the following interesting statement, and my thanks are

due him not only for it, but for much additional assistance. He writes:

"Joseph Leidy told me himself that he was looked upon by his classmates when at school as a peculiar boy. He cared nothing nor did he take any interest in their games. His penchant seemed to be collecting of natural history objects, he was particularly interested in plants and animals, and his interest at first was to collect beautiful objects in nature although later on his interest extended towards knowing how plants and animals were made—just as he says other boys were interested in the construction of their toys. I have a book of drawings of different species of shells, which were made in 1833—with the Latin names attached—showing at the early age of ten, an interest which I do not find recorded in the life of any other naturalist, from a large list I have reviewed. His interest in collecting plants resulted in long tramps, at distant places from home. His mother became disturbed at his late home-coming and determined to find a suitable person to accompany him. It so happened that the colored cook of the family had a son who was engaged in collecting herbs for a well-known physician in Burlington, N. J. This colored youth had some knowledge of field botany, and was selected on this account to accompany Leidy after school hours on his excursions. One field rich in wild flowers was where the old Reading Railroad station stood at 9th and Green Streets, and frequently he found his way to the Wissahickon Valley, to which later in life he directed the attention of botanists as the richest field in variety and species to be found in the confines of Philadelphia.

Leidy told me he first gathered the leaves and flowers which he kept between the leaves of old newspapers. Many of these became the foundation of the fine herbarium, which at his death, or before, was given to the Botanical Department of the University of Pennsylvania.

His interest in animal life began at the same time. Dr. Griscom used to relate how at the age of 11, when making a professional call at his father's house, he saw the boy lying on his stomach, with a worm which he was dissecting pinned on a board, but I have heard Leidy relate that the first animal he dissected when a boy was a common barnyard fowl—and from this he dissected any animal he could lay hold of. At the age of nine years he collected silk worms with a brother. These he raised and was always careful to remove the sick, or those suffering from mould disease from the rest. (He refers to this in print in his "Flora and Fauna.")

His first interest in mineralogy was aroused by a lecture delivered by an itinerant lecturer when at school—who described to the boys different minerals—felspar, quartz, and various forms of crystals—how felspar and quartz and mica went to form gneiss, and of the formation of granite. His mental appetite was so whetted by this lecture that at the end of school hours he, with a number of boys, went to a dyke on a nearby street, where laborers were working. Here Leidy says he broke the rocks and stones, and carried home those which attracted him, and, to use Leidy's words, "thus began my first collection of minerals."

Having cleared the vicinity of his home of the various species of plants, he persuaded his father to purchase a botany for him, and after school hours was permitted to study the dry specimens of medicinal plants in the drug shop of a

cousin, Dr. Napoleon B. Leidy, a graduate of the University of Pennsylvania in 1833.

You will see from all this that Leidy was born with a love of nature."

The other speakers have dealt with the personality of Leidy so thoroughly that I may not deal with it here save to point out that he loved work for its own sake, that he was wonderfully patient in observation, and that he utilized deduction and imagination only when he had exhaustively studied his subject. It has been said that a fault in Leidy was a lack of imagination and that if he had not possessed this fault he would have gone further. It is true that imagination, given free rein, or guessing, may enable a man to reach a conclusion by a wild leap on rare occasions. But guessing was foreign to the very fibre of Leidy's mind, whereas deduction and reason were always on duty. In numerous instances Leidy made observations, reached deductions, placed them on record, and the rest of the world did not have the intelligence to utilize them.

Discussing the question as to how infection may occur, we find that Leidy, in a lecture before the medical class of the University of Pennsylvania on October 11th, 1859, spoke as follows: "I presume it is known to most of you that if a vessel of rain or river water, free from micro-organisms, is placed in the window of a room during warm weather, in the course of a few weeks it becomes peopled with numerous minute plants and animals. The circumstance is usually explained by supposing that the germs of these minute organisms are incessantly floating with the dust of the air, and settling in the vessel of water, they there find the conditions favorable, and become actively developed." No bacteriologist of today could discuss the distribution of pathogenic bacteria in better words than these save that the vessel of water is to be substituted by the words "fluids of the body."

Again in the same address he points out that "germs are the minutest of solid particles" and adds that "there are certain specific living beings—as for example contain monads, which are so exceedingly minute that it has been estimated that 500,000,000 sometimes people a single drop of water," and we now know that this is the case with pathogenic bacteria, as for example the myriads of typhoid bacilli, which render the urine of the patient cloudy.

A year ago in an address delivered to celebrate the Centenary of the birth of Louis Pasteur, I pointed out that here in our midst

there lived another whose career ran strangely side by side with that of Pasteur, namely, Joseph Leidy. Pasteur was born December 27, 1822, the son of a small tanner; Leidy was born September 9, 1823, the son of a small hatter. Both lived almost the same span in years; both were alike as to their physiognomy and spacious brain cap; both were alike as to their greatness and their power; both struggled with a poverty of cash, and both reached the richness of achievement; both taught rudimentary things in order to keep the wolf from the door; and both were elected to professorships early and at about the same age. While Pasteur was interested in chemistry and crystallography, Leidy was interested primarily in biology, mineralogy, and precious stones; when Pasteur was studying the microscopic parasites of animals and men, Leidy was becoming the greatest living authority on the microscopic parasites.

As Professor Chittenden, of Yale, said in his address on Pasteur in December, 1922, in this city, "Pasteur was primarily a chemist and it was as a chemist that he opened the gates to paths which eventually led to new and wonderful conceptions in the science and art of medicine." Leidy was primarily a medical student and biologist; he also opened gates and paths which led to wonderful conceptions, and it is a noteworthy fact that Leidy, in some of his work which influenced medicine, antedated the work of Pasteur by many years. It was not until 1853 that Pasteur's work began to be biological, and it was in 1843 that Leidy made his first report which had a definite bearing on physiology and medical science. While a student of medicine he first observed the amoeboid movement of white blood cells in *Helix*, a land snail, and described its projections. It is true that he did not fully grasp the significance of this observation, because in his charmingly frank way, he writes, "I could not account for this phenomena and concluded it was due to endosmosis or decomposition." Today we know that this amoeboid movement is one of the essential phases of inflammation in warm-blooded animals and that this power of the white cells to outwander results in one of the most important activities of the human body to oppose bacteria which have entered it.

Again, it is a noteworthy fact that although Hilton discovered the *Trichina spiralis* in man in 1833, and that Owen described and named it in 1835, it was in 1846 that Leidy found it in the hog, thereby revealing the source from which human infestation arises,

with the further observation that he found that exposing the trichina to the heat of cooking destroyed the vitality of the parasite.

In 1851 Leidy's epoch making report the *A Flora and Fauna within Living Animals* was made, and published in the "Smithsonian Contributions to Knowledge," but the observations on which this report was founded were carried out years before. In this report Leidy clearly recognized the importance of parasites in the production of disease, and in his preface used the following words:

"Within living beings, i.e., within their cavities or the parenchyma of the organs, of course, all the indispensable conditions of life exist, and consequently we cannot wonder at their being infested with other living beings adapted to their parasitic position. Nevertheless, although the conditions of life are necessarily ever present in living beings, yet these frequently do not contain parasites. There are many circumstances besides those essential to life in general, which influence the existence or non-existence of such forms. One of the most important of these circumstances is the convenience or ease of access, or of entrance to the living body infested.

"Within the living, closed, organic cell parasites very rarely, if ever, exist, because it is liquid matter only which can endosmose through cell-membrane, and therefore, solid germs cannot enter, and hence the unfrequency of true entozoa in vegetables. Entozoa may and do penetrate through living tissues, but it is entirely by the mechanical process of boring.

"The intestinal canal of animals is most frequently infested by entoparasites on account of the ease with which their germs enter with the food.

"Aquatic animals are more troubled by entozoa than those which are terrestrial, because the water affords a better medium of access than the air.

"Terrestrial animals, on the other hand, are more infested by ectoparasites because their covering of hair, wool and feathers is more favorable to their protection and reproduction. A low degree of organic activity and slowly digestible food favor the development of entoparasites, and hence they are more frequent in the relatively sluggish herbivora than in the carnivora. Comparatively indigestible food, and such as contains but a small proportion of nutritive matter, from its long retention in the alimentary canal, favors the development of entozoic and entophytic germs more than that in which the contrary conditions prevail.

"Animals subsisting upon the endosmosed juices of the tissues of other animals, and of plants, are rarely infested by parasites, as in the case of the hemipterous insects, aphides, etc., because such food is necessarily free from parasites or their germs. Entozoa themselves, on this account, are not infested.

"On the other hand, if the liquid food be open to the air, parasitic germs may be readily introduced into the animal, as in the case of the common house-fly, which often contains myriads of a species of *Bodo*.

"Food swallowed in large morsels favors the introduction of attached parasites; hence these are frequently found in reptiles, and even in birds, which are, among the vertebrata, of the highest organic activity.

"Animals of feeble organic activity using solid food, which is very slowly digested, and contains little nutriment, are rarely free from parasites. This is the case with the coleopterous insect *Passalus*, and the myriapod *Julus*.

"Cooking food is of advantage in destroying the germs of parasites; and hence man, notwithstanding his liability to the latter, is less infested than most other mammalia. Did instinct originally lead him to cook his food, to avoid the introduction of parasites?

"Entozoa are more abundant than Entophyta, because the power of voluntary movement favors them in their transmigrations, and renders them less liable to expulsion from the intestinal canal.

"In many animals Entozoa and Entophyta are almost never absent, and probably when in their natural habitation, and few in number, or not of excessive size, they are harmless, as observed by Dujardin in the introduction of his excellent work on intestinal worms: 'les helminthes se développent dans un site qui leur convient, sans nuire plus que les lichens sur l'écorce d'un arbre vigoureux. Ils ne peuvent devenir nuisibles, généralement, que par suite d'une multiplication excessive, laquelle semble alors être une des conséquences d'un affaiblissement provenant d'une tout autre cause, d'une mauvaise alimentation, du séjour dans un lieu froid et humide, etc.; sans cela, les helminthes naissent et meurent dans le corps de leurs hôtes, et peuvent paraître et disparaître alternativement sans inconvénients.'

"Many important diseases have been supposed to originate from parasitic animals and vegetables. The former are not the true Entozoa, for these are too large, and may be detected by the naked

eye, but they are considered to be animalculae so small that they cannot be discovered even with the highest powers of the microscope. But, independent of the fact that the existence of such entities is a mere suspicion, none of the well-known animalculae are poisonous. At various times, I have purposely swallowed large draughts of water containing myriads of *Monas*, *Vibrio*, *Euglenia*, *Volvox*, *Leucophrys*, *Paramecium*, *Vorticella*, etc., without ever having perceived any subsequent effect.

"The production of certain diseases, however, through the agency of entophyta, is no longer a subject of doubt; as in the case of muscardine in the silk-worm, the mycoderm of *Porrigio favosa* in man, etc.; but that malarial and epidemic fevers have their origin in cryptogamic vegetables or spores requires yet a single proof. If such were the case, these minute vegetables and spores, conveyed through the air, and introduced into the body in respiration, could be detected. The minutest of all known living beings is the *Vibrio lineola* of Müller, measuring only the 36,000th of an inch, and the smallest known vegetable spore is very much larger than this, whilst particles of inorganic matter can be distinguished the 200,000th of an inch in size.

"I have frequently examined the rains and dews of localities in which intermittents were epidemic upon the Schuylkill and Susquehanna Rivers, but without being able to detect animalculae, spores, or even any solid particles whatever. I have examined the air itself for such bodies, by passing a current through clear water. This was done by means of a bottle, with two tubes passing through a cork stopper; one tube dipping into the water, the other reaching not quite to its surface. By sucking upon the latter tube, a current of air passed through the former, and was deprived in its course of any solid particles. Ordinarily, when the atmosphere was still, early in the morning, or in the evening, neither spores nor animalcules could be detected. When piles of decaying sticks or dry leaves were stirred up, or the dust was blown about by the wind, a host of most incongruous objects could be obtained from the air; none, however, which could be supposed capable of producing disease.

"To assert, under these circumstances, that there are spores and animalculae capable of giving rise to epidemics, but not discernible by any means at our command, is absurd, as it is only saying in other words that such spores and animalculae are liquid and dis-

solve in the air, or in a condition of chemical solution. That the air may be poisoned by matters incapable of detection by the chemist is proved by the emanations from such plants as the *Rhus vernix Hippomane mancinella*, etc."

At first glance these words seem to indicate that Leidy did not believe in microscopic parasites. On the contrary he indicates that if proper means are used they will be discoverable.

I am not competent to attempt to decide who was the first investigator who, to all intents and purposes, gave the death blow to the theory of spontaneous generation. In the recently celebrated Centenary of the birth of Pasteur a statement, which was emphasized more than any other, was that one of his chief claims to fame rested upon his refutation of this theory. It is true that the investigations carried out by Pasteur helped to give it its final congé and it is also true that these conclusions led him into the bacteriological field, with results industrial and medical which are of the utmost importance, but we must not overlook the studies of Schulze of Berlin, 1837. Leidy duplicated the experience of Schulze, using three different flasks, carrying of the test from July 1850 to December 1851, and reached the same conclusions. The experiment consisted in heating a mixture of water and dead vegetable and animal matter to 212° F., and attaching to the container "a pair of Liebig bulbs, one of which contained sulphuric acid, the other a solution of potassa and through these only could the exterior air have access to the interior." "The apparatus was placed in a window where it received the full influence of light and the necessary temperature for the production of life and the air within the vessel was daily removed from May until August by blowing through the H₂SO₄ whereby it was deprived of moisture and particles." "During all that time not even the simplest animal or vegetable forms were produced," while in an open vessel so exposed a host of organisms developed.

It was not until 1863 that Pasteur made his experiments with sealed and unsealed tubes containing bouillon, thirteen years after Leidy and twenty-four years after Schulze. It is said that Lister was largely inspired by Pasteur's work to make his epochal discoveries in antiseptic surgery. One cannot avoid the thought that had earlier surgeons followed the views which Leidy advanced, and carried them to a practical conclusion, many thousands upon thousands of lives might have been saved, for I may add for those

of my audience, who know not matters medical, that the determination of this issue, which at one time rocked the scientific world, was largely responsible for the development of asepsis in surgery and for our modern conception of infectious diseases. As a matter of fact two factors played a large part in the credit given to Pasteur. First, the world was at last ready to acknowledge the folly of the spontaneous generation theory, and, secondly, that Pasteur saw the practical deductions to be drawn. Perhaps it might be said that in this, and other investigations, Leidy was like Benjamin Franklin in his early work on electricity, and Pasteur was like Faraday in its practical utilization.

As illustrative of what appears to us today as weird conceptions as to spontaneous generation, I may call attention to the experiment of Crosse and Weekes, quoted by Leidy, in which they attempted the production of the so-called *Acarus crossii* by the aid of electricity. It is not often that we find Leidy using as strong terms as he did in referring to this work. In a footnote on page 12 of "Flora and Fauna," he uses these words: "The experiments of Crosse and Weekes appear to me exceedingly absurd; for in the first case, how were the carbon and nitrogen of the animal body to be derived by the play of a voltaic current upon a solution of silicate of potassa? If they previously existed in the water, was it not quite as probable that the ova of Acari were there also? Again, when the solution of ferrocyanide of potassium was made the womb of life by the electrical current, why could not the embryology of the new being be observed? *Acarus* is a highly complex animal, presenting a well-developed tegumentary, muscular, and nervous system, and a digestive, respiratory and generative apparatus. The gap between the inorganic world and the acarus is greater than that between the latter and man!"

In a lecture delivered to the medical class, October 11th, 1859, speaking of spontaneous generation, he said, "If from a pot of earth you told some one you had developed an egg and from this egg hatched an eagle he would consider you a fool or a madman. If, however, you mention the fact that in your cellar for the first time in many years a group of mushrooms had sprung up, as if by magic, he would probably go into a learned disquisition as to the manner in which a concatenation of dynamical physico-chemical forces of nature operating on inorganic molecules, had produced a

polarity which resulted in the production of the peculiar organism denominated a fungus." Truly this is a piece of delicious satire.

The bearing of the determination that spontaneous generation does not exist has its impact in medicine because it emphasizes the fact that every infection is due to another infection, that is, no infection develops spontaneously. The deduction of course is that the conquest of infectious disease must be attained by preventing the infected one from being a nidus for the spread of the disease, and by the tracing of the infection to the source from which he in turn received it. By this means typhoid fever has become in many places practically non-existent, and this holds true of many other maladies.

It is remarkable that Leidy's oft repeated observations of moulds and fungi in crickets, etc., did not lead to more direct bacteriological work.

There is no fact so generally recognized today as that flies are disseminators of disease, yet such recognition may be said to be of recent existence. Nevertheless, Leidy in the PROCEEDINGS of the Academy of Natural Sciences in November, 1871, said that "at this time, during the prevalence of smallpox, he was reminded that he had entertained the view that flies were probably a means of communicating diseases to a greater degree than was generally suspected. From what he had observed in one of the large military hospitals, in which hospital gangrene had existed, during the late rebellion, he thought flies should be carefully excluded from wounds. Recently he noticed some flies greedily sipping the diffluent matter of some fungi of *Phallus impudicus*. He caught several flies and found that on holding them by the wings they would exude two or three drops of liquid from the proboscis, which, examined by the microscope, were found to swarm with spores of the fungus. The stomach also was filled with the same liquid, swarming with spores." With our present knowledge it seems beyond belief that this observation was not seized upon as of the greatest import, yet I venture to say that every one of my auditors will recall the days when the fly was allowed to roam at will in great numbers over the food of even the well-to-do, and to creep all too often over the lips of the patient apathetic from typhoid fever. Leidy presented his facts, but failed to emphasize their general importance in such a way as to attract attention, and no

one apparently had the initiative to start what is now called the "campaign to swat the fly."

Again we find this interesting observation, with a practical deduction, which also seems to have lacked general recognition possibly because it was reported to a group of men devoted to science in distinction from men who, practising medicine, would naturally have made a practical application of the fact. Thus in 1873 before this Academy, he showed a mouse, with whitish masses adherent to the ears, side of face and nose, which had been captured in the Children's Wards of Blockley Hospital. Leidy reported these masses were a fungus, a *Torula* or *Oidium*, resembling that found in aphtha, and then with his usual caution, said, "perhaps the disease in mice is the result of feeding upon articles imbued with adherent portions of apthous matter from the mouths of children, and perhaps also the latter may become affected from diseased mice contaminating the food or drink used by the children." Here is then an early contribution to the spread of infection by rodents now recognized as the chief means of spread of the most vicious of diseases, such for example as plague.

But Leidy did not confine himself to researches on the lower animals. He often studied factors affecting human beings as well. Other speakers have already dealt with his work as a helminthologist adequately, so I will not deal with this very important topic.

As early as 1847, his cousin, then the Coroner of Philadelphia, appointed him Coroner's Physician and he was called upon to determine whether certain blood stains in a murder case were human or those of a chicken. As a result of his studies he testified that, while he could not swear that they were human blood stains, he could state that they were not due to chicken blood.

Again we find in the *Medical and Surgical History of the War of the Rebellion*, p. 109, et seq., 310-311 et seq., 2nd part, a statement by Woodward that Leidy's autopsies constitute by far the most important contributions to the pathological anatomy of the non-ulcerative form of intestinal inflammation made during the war.

In 1886, before the College of Physicians of Philadelphia, he reported on anchylostomum duodenale in the domestic cat, and advised medical men to be on the lookout for infection in mankind, using those pregnant words: "the finding of this parasite in the cat in this country renders it probable that it may also infect man, and it is probably one of the previously unrecognized causes of per-

nicious anæmia." It is not needful to call attention to the fact that millions of human beings have been found to have this infection in recent years and that hundreds of thousands of lives have not only been saved but made useful by the war waged against this parasitic infection. Here again it would appear that notwithstanding the universal confidence of all men in Leidy's powers of observation and accuracy of statement, his views seem to have fallen upon stony ground, for many years elapsed before the importance of this subject was recognized.

As late as 1891 he published papers discussing the introduction of parasites into the United States by different races of emigrants, pointing out that the *trichinae spiralis* appeared in the hog in this country after it had been found in man in England, that the liver fluke was introduced by Chinamen, and that the guinea-worm found its way to our tropical areas by negroes from Africa. These points made in the PROCEEDINGS of the Academy of Natural Sciences, in April 1891, were only suggestions, because in the same report the presence of flukes in a considerable number of wild and domesticated animals was recorded, leading him to the belief that if such importation occurred it must have taken place many years before.

Many years ago I served on a committee of the Pathological Society of Philadelphia to investigate the prevalence of disease in animals slaughtered in the abattoirs of Philadelphia. As it was in the middle "eighties," the question of tuberculosis did not loom as large then as it did later, but I well recall that in the discussion of the report to the society, Leidy remarked that for several decades he had made a habit of frequenting the Twelfth Street Market somewhat as a purchaser, but possibly more as a naturalist, and that in all that time he had found only one instance of grave disease in an internal organ of a food animal, and that was a cancer involving the liver of a turkey. I also recall that he added, with that quiet smile of his, that so far as he knew there was no reason why such a liver should not be cooked and eaten.

This anecdote as to his peregrinations in the market place is an interesting illustration of the fact that Leidy saw things of interest everywhere he went. A flower or a vegetable in the market stall gave him a story that he could get only in far away fields and gardens.

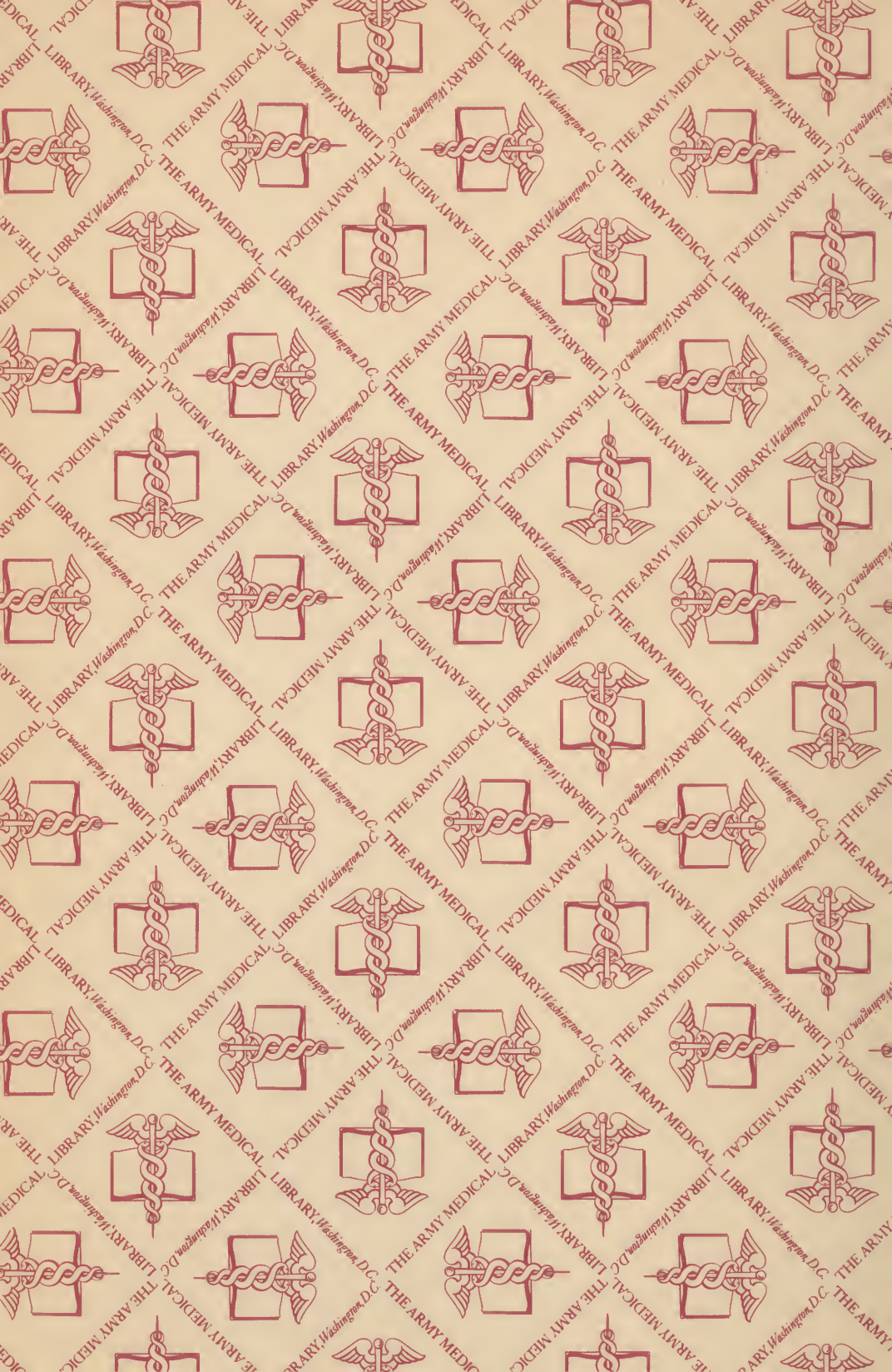
It is not possible to discuss in detail or even to mention by name the various subjects, closely connected with medical science, which

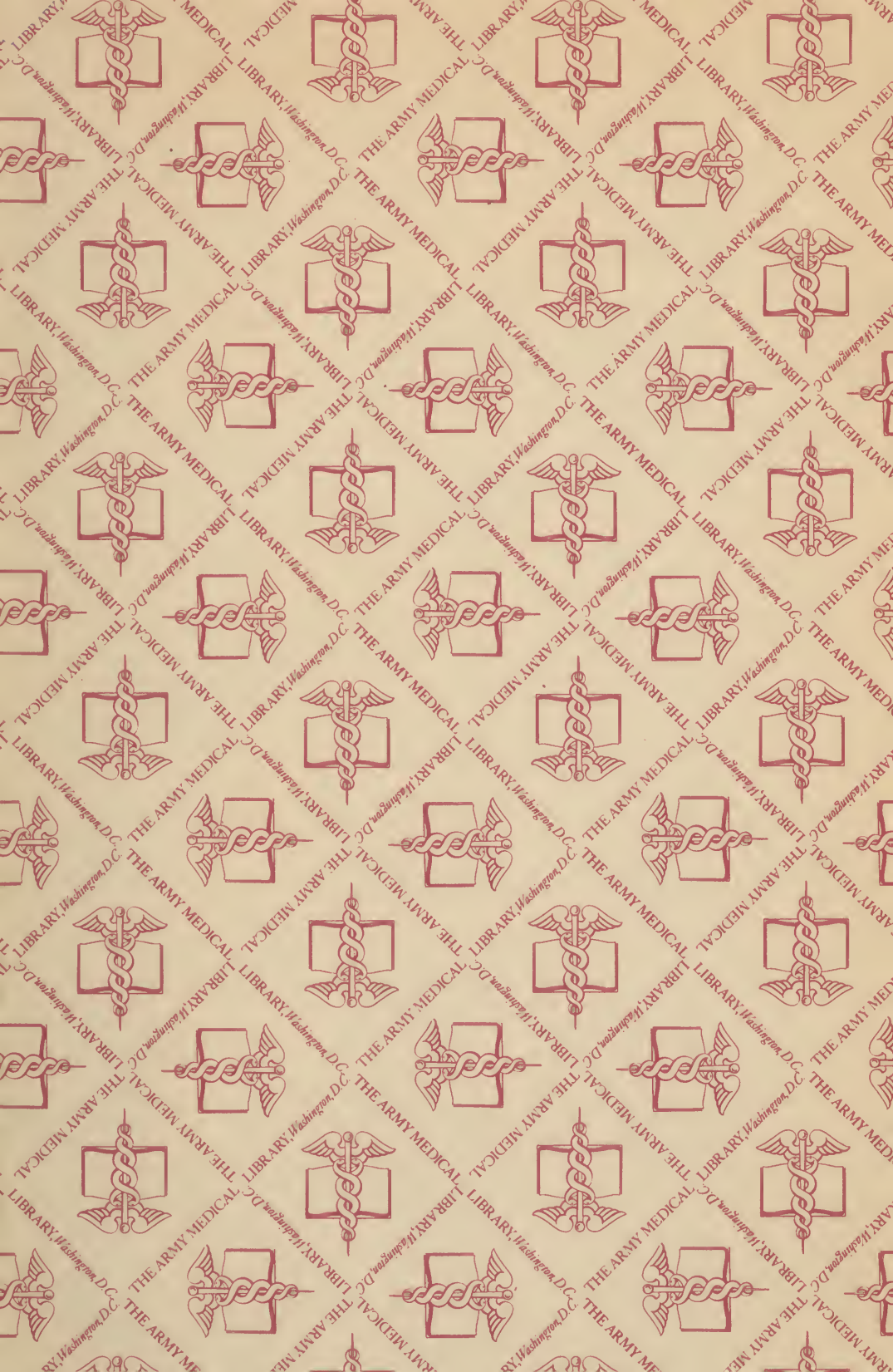
were the results of Leidy's unflagging industry. In 1846 he reported to this Academy on the vocal cords as membranes, and 1847 recorded his researches on articular cartilage. As early as 1853 he translated a pathological atlas with notes and comments. In 1851 he made two reports on experiments in transplanting cancer, and in 1858 he recorded his observations on intestinal absorption, and presented researches on death due to chloroform to this Academy. In 1877 he studied the contamination of drinking water as a source of disease. In 1882 he contributed to "Holmes' System of Surgery" the articles on parasites and the treatment of the effects produced by venomous serpents and reptiles, and in the same year that upon intestinal parasites to "Pepper's System of Medicine." In 1883 he recorded his studies on the temporal bone, described the attic for the first time, and took issue with Huxley on the various centers of ossification. In the *Therapeutic Gazette* for June 15th, 1886, he wrote on the "Pathological Importance of the Lower Forms of Life." In 1889 his book on "Human Anatomy" appeared with its terms anglicized and simplified, a protest against the use of personal names for anatomical things. Again, in 1890, he presented to this Academy "Researches on Ticks," which parasites have since proved such important factors in the transmission of disease.

I have been told that, when on his deathbed, Leidy noticed that the carpet in his room was patterned with flowers. He remarked that he could not understand why this could be, for who could think of walking on flowers. Leidy regarded flowers not as most mortals do, only because they please the eye. He saw in each a story of natural history. The petal, the pistil, the leaf, all told him a double story of life and development as well as beauty. How many of us poor mortals pass through life ignorant of all the charm and wonder that Leidy enjoyed. To see in every living thing, or in one dead for centuries, an interesting story, or to put it otherwise, to see in every thing living the possibility of its developing like a beautiful fan on expansion. Like the bee he passed from what to him was one flower to another flower, and in each case drew his fill of the nectar of Nature's wonders. If those of us who were so fortunate as to sit at his feet as students could only have grasped more thoroughly what Leidy personified how blessed would have been our after lives.

Gentle and learned, kindly and wise, accurate and truthful,

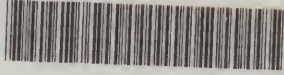
modest yet strong, animated by no thought save that of interest in his task, he now, more than thirty years after his death, is a living presence in the minds and hearts of those who love science for science's sake, and will live in the minds and hearts of those who follow after us. In this hurley-burley world, when nearly all men are self-seekers more or less, and chiefly more, the memory of Leidy and his labors is a benediction to all those who know enough to appreciate, not alone what he did, but the example he unconsciously set before all men.





WZ 100 qL527 1923

55811570R



NLM 05295135 9

NATIONAL LIBRARY OF MEDICINE